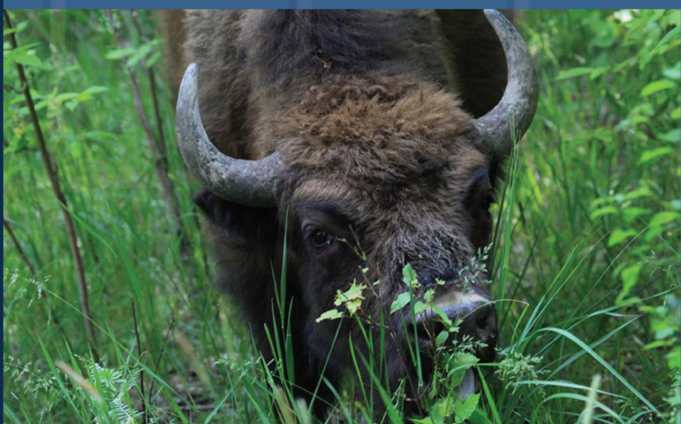
Fourth National Communication of the Republic of Moldova

Submission to the United Nations Framework Convention on Climate Change



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Fourth National Communication of the Republic of Moldova

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FOREWORD

FOREWORD

It is well known that climate change is a global ecological problem that endangers sustainable development of the humanity. It can have diverse negative impact such as world ocean level rise, increased frequency of natural disasters (floods, droughts, heat waves, hurricanes and tornadoes), higher vulnerability of natural and artificial ecosystems to new climate conditions, etc. This requires from the world's nations to undertake actions aimed both to minimize the climate change process as well as to mitigate its potential consequence.

The Fourth National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change has been developed with the financial assistance of the Global Environment Facility through the Project "Republic of Moldova: Enabling Activities for the Preparation of the First Biennial Update Report and the Fourth National Communication under the United Nations Framework Convention on Climate Change", initiated on July 7, 2014 and completed on December 31, 2017; managed by the United Nations Environment Programme and implemented by the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment of the Republic of Moldova.

In comparison to the Third National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change, this Report presents an updated overview of the state of work in the Republic of Moldova for the main issues covered by the Convention. They affect the assessment of greenhouse gas emissions pace and dynamics at national and sectoral level, the mitigation measures adopted at national level, the assessment of vulnerability and the needs for adaptation to new climate change conditions for key sectors of the national economy and human health, the capacity support and needs in order to decrease these emissions at a larger scale, respectively the capacity support and needs in order to ensure better resilience and adaptation to new climate conditions determined by the phenomenon of climate change.

It is important to note that identifying these needs and mitigation targets for the future has been taken based on potential GHG mitigation scenarios at national and sectoral level until 2030, considered to be for the Republic of Moldova as the most likely. These assessments served as basis for developing the mitigation targets included in the First Intended Nationally Determined Contribution, prepared in accordance with Decisions 1/CP.19 and 1/CP.20, for the Paris Agreement (2015) – an agreed outcome with legal force under the Convention, applicable to all Parties, in line with keeping global warming by 2100 below 2°C, as compared to the preindustrial period.

To be noted, the Paris Agreement was signed by the Prime Minister of the Republic of Moldova in New York on September 21, 2016, and was subsequently ratified by the Parliament through Law No. 78 from 04.05.2017 for the ratification of the Paris Agreement (Official Monitor No. 162-170 from 26.05.2017), and the GHG reduction targets set out in the Intended Nationally Determined Contribution of the Republic of Moldova were subsequently officially approved at national level by the Government Decision No. 1470 from 30.12.2016 regarding the approval of the Low Emissions Development Strategy of the Republic of Moldova by 2030 and the Action Plan for its implementation (Official Monitor No. 85-91 from 24.03.2017).

According to its INDC, the Republic of Moldova intends to achieve an economy-wide unconditional target of reducing its greenhouse gas emissions by 64-67 per cent below its 1990 level in 2030 and to make best efforts to reduce its emissions by 67 per cent. The reduction commitment expressed above could be increased up to 78 per cent below 1990 level conditional to, a global agreement addressing important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale commensurate to the challenge of global climate change. GHG emissions reduction targets have been set in an emission budget covering the period from January 1, 2021 to December 31, 2030.

At the same time, it should be noted that the targets associated with adaptation to new climate conditions determined by the phenomenon of climate change for key sectors of the national economy and human health, set out in the Intended Nationally Determined Contribution of the Republic of Moldova, were approved at national level by the Government Decision No. 1009 from 10.12.2014 regarding the approval of the Republic of Moldova's Strategy for Adaptation to Climate Change by 2020 and the Action Plan for its implementation (Official Monitor No. 372-384).

The development of the Report as well as the subsequent implementation of the Republic of Moldova's Strategy for Adaptation to Climate Change by 2020 and the Action Plan for its implementation, the Low Emissions Development Strategy of the Republic of Moldova by 2030 and the Action Plan for its implementation, represent an essential contribution of our country to addressing climate change both nationally and globally.

Ion APOSTOL
Vice Minister,
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LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

AA	Association Agreement EU-Republic of Moldova
A&A ROSC	Accounting and Auditing Reports on the Observance of Standards and Codes
A1B	SRES Emissions Scenario
A2	SRES Emissions Scenario
AC	Air Conditioning
ADA	Austrian Development Agency
ADD	Acute Diarrheal Diseases
AEE	Agency on Energy Efficiency
AEZ	Agro-Ecological Zone
$AGDD_{5, 10, and 15°C}$	Active Growing Degree Days
AGEPI	State Agency for Intellectual Property
AGeoM	Agency for Geological Production and Exploration
AI	Aridity Index
AITT	Agency for Innovation and Technology Transfer
AOGCMs	Coupled Atmosphere–Ocean Global Climate Models
AMP	External Assistance Management Platform
ANCDI	National Agency for Research, Development and Innovation
ANRE	National Agency for Energy Regulation
APR	April
AR4	IPCC Forth Assessment Report
AR5	IPCC Fifth Assessment Report
Art.	Article
a.s.	Active Substance
ASM	Academy of Science of Moldova
ATULBD	Administrative-Territorial Units on the Left Bank of Dniester
Aug	August
B	Billion
B1	SRES Emissions Scenario
BAS	Business Advisory Service
BAT	Biologically Active Temperature Index
BAU	Business as Usual Scenario
BCC-CSM1.1	Global Circulation Model developed by the Beijing Climate Centre, China Meteorological Administration
BMZ	Federal Ministry for Economic Cooperation and Development, Germany
BI	Bodman Severity index
BOD	Biochemical Oxygen Demand
BNU-ESM	Global Circulation Model developed by the College of Global Change and Earth System Science, Beijing Normal University
BSP	Budget Support Programme
BUR	Biennial Update Report
°C	Celsius degrees
C	Carbon
Ca^{++}	Calcium ions
¢	Cents
CAA	Central Administrative Authorities
CanESM2	Global Circulation Model developed by the Canadian Centre for Climate Modelling and Analysis
CBD	Convention on Biological Diversity
CBT	Climate Budget Tagging
CC	Climate Change
CCA	Climate Change Adaptation
CCAS	Climate Change Adaptation Strategy
CCA KMS	Climate Change Adaptation based on Knowledge Management Strategy
CCSM4	Global Circulation Model developed by the National Centre for Atmospheric Research
CEDB	Council of Europe Development Bank
CCl_4	Carbon tetrachloride
CCO	Climate Change Office
CCPP	Combined Cycle Power Plant
CDD	Consecutive Dry Days
CDM	Clean Development Mechanism
CDP	Capacity Development Plan
CE	Council of Europe
CER	Certified Emission Reductions
CESM1(CAM5)	Global Circulation Model developed by the Community Earth System Model Contributors
CF_4	Perfluormetnane
C_2F_6	Perfluorethane
C_3F_8	Perfluorpropane
C_4F_{10}	Perfluorbutan
$c\text{-}C_4F_8$	Perfluorciclobutan
C_5F_{12}	Perfluorpenthan
C_6F_{14}	Perfluorhexan
CFC	Chlorofluorocarbons
CFF	Climate Fiscal Framework
CFM	National Commission for Tax Environmental Reform
C.I.F.	Cost, Insurance and Freight
CIS	Commonwealth of Independent States
CH_4	Methane
CHP	Combined Heat Power Plant
CHE	Hydro Power Plant
CHEAP	Hydro-Power Plant with Accumulation by Pumping
CHPD	Distributed (Small Capacity) Combined Heat and Power Plant
Cl^-	Ions of chlorine
CLTS	Coefficients of the linear trend slope
CO	Carbon monoxide
CO_2	Carbon dioxide
COEST	Committee for Eastern Europe and Central Asia of the Council of the European Union
COP	Conference of the Parties
COPS	Comite politique et de securite (Political and Security Committee - PSC)
CORINAIR	European Emissions Inventory Guidebook developed by European Environment Agency
cm	Centimeter

cm^2	Square centimeter
CMEIMI	Integrated Ecological Monitoring and Information Management Centre
CMIP3	Coupled Model Intercomparison Program – phase 3
CMIP5	Coupled Model Intercomparison Project – phase 5
CPMT	Central Program Management Team
CNRM-CM5	Global Circulation Model developed by the Centre National de Recherches Météorologiques / Centre Européen de Recherche et Formation Avancée en Calcul Scientifique
CNSPMP	National Center of Scientific and Applied Preventive Medicine
CNG	Compressed natural gas
COD	Chemical Oxygen Demand
CPA	Central Public Authorities
CPA	Cooperation and Partnership Agreement
CPP	Condensing Power Plant
CPS	Country Partnership Strategy
CS	Country Specific
CSC	Carbon Storage and Capture
CSDI	Cold spell duration
CSIRO-Mk3.6.0	Global Circulation Model developed by the Commonwealth Scientific and Industrial Research Organization in collaboration with Queensland Climate Change Centre of Excellence
CSSDT	Supreme Council for Science and Technology Development
CTEM	Moldovan Central Heating Plant
CV	Coefficient of variation
CWD	Consecutive Wet Days
CzDA	Czech Development Agency
D	Default
Dal	Dekaliter
DCFTA	Deep and Comprehensive Free Trade Agreement
DCFTZ	Deep and Comprehensive Free Trade Zone
DEPA	Danish Environment Protection Agency
DJF	Winter Season: December, January and February
DKK	Danish Krone
DOC	Degradable Organic Carbon
DOC_F	Dissimilated DOC fraction
dm	Decimeter
d.m.	Dry matter
DNA	Designated National Authority
DRR	Disaster Risk Reduction
DTR	Diurnal Temperature Range
E_A	Potential Evaporation, Annual
EaP	Eastern Partnership
EaPIC	Eastern Partnership Integration and Cooperation Programme
EB	Energy Balance
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EC-EARTH	Global circulation model developed by the EC-EARTH consortium
EEA	European Environment Agency
EEE	Electrical and Electronic Equipment
EEA	Energy Efficiency Agency
EEC	European Economic Community
EEF	Energy Efficiency Fund
EEN	Enterprise Europe Network
EET	Equivalent-Effective Temperature of Miserand Index
EF	Emission Factor
EFRC	Environmental Fiscal Reform Commission
EHGeoM	Hydrogeological Expedition of Moldova
$EGDD_{5,\ 10,\ and\ 15^oC}$	Effective Growing Degree Days
EIA	European Integration Alliance
EIB	European Investment Bank
EIC	Environmental Information Centre
$\bar{E}$	Mean annual evaporation
$\bar{E}_m$	Maximum Possible Evaporation
$\bar{E}_{zon}$	Multiannual mean amount of evaporation from the surface of the catchment area
EMEP	Programme on Observations and Assessment of Long-Range Transboundary Air Pollution in Europe
En-C	Energy Community
EnMS	Energy Management System
ENPEP	Energy and Power Evaluation Program
ENPI	European Neighborhood and Partnership Instrument
ENTSO-E	The European Network of Transmission System Operators for Electricity
ENVSEC	Environment and Security Initiative
E-OBS dataset	European Climate Assessment dataset
EP	Eastern Partnership
E5P	Eastern Europe Energy Efficiency and Environmental Partnership
ESATA	Economic and sector activity and technical assistance
ESCO	Energy Service Company
ET	Effective Temperature Index
ETCCDI	Expert Team on Climate Change Detection and Indices
ETD	Electrical Transport Department in Chisinau
EV	Emissions Volume
EU	European Union
EUA	European Union Allowances
EU ETS	European Union Emission Trading Scheme
EUREM	European Energy Manager Training
EUR	Euro
EURO-CORDEX	Coordinated Downscaling Experiment — European Domain
E_V	Potential evaporation, in vegetation period
EV	Emission volume
EWS	Early Warning System
eq	Equivalent
FAO	Food and Agriculture Organization
FD	Frost Days
FES	Emission Factor in the National Power System

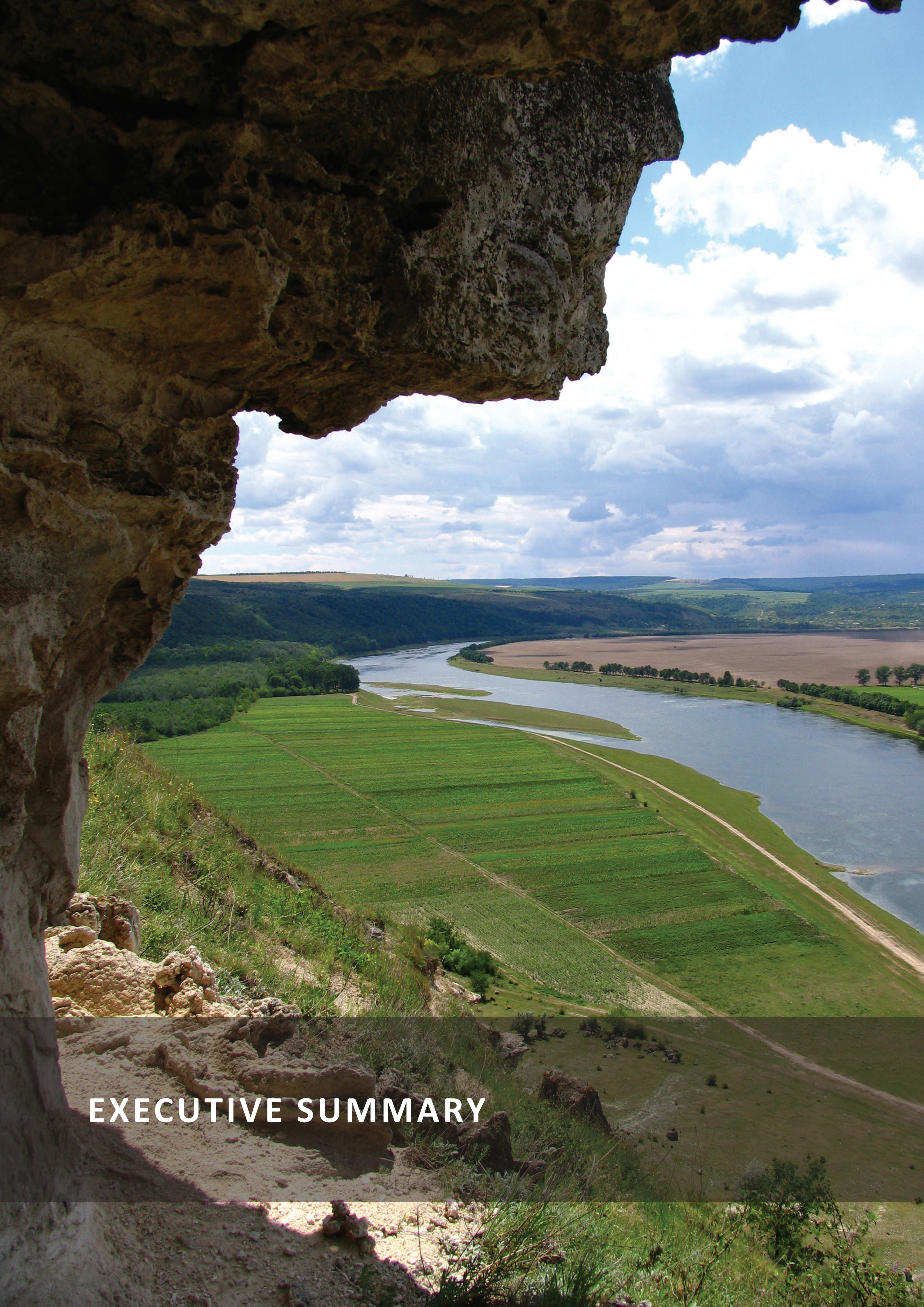
FEEF-MO	Funding for Energy Efficiency of the European Union for the Republic of Moldova
FEN	National Environmental Fund
FFD	First Frost Day
FNC	First National Communication
F.O.B.	Free on Board
FOD	First Order Decay Method
FP	Frost Period
FP7	EU's 7th Framework Programme for Research and Development
FRMI	Forestry Research and Management Institute
g	Grams
g.c.e.	Grams of Coal Equivalent
GASFOR	Modeling Carbon Sequestration in Forested Landscapes
Gcal	Gigacalory
GCM	Global Climate Model
GCOS	Global Climate Observing System
GD	Government Decision
GDP	Gross Domestic Product
GEF	Global Environmental Facilities
GEFS	Grid Emission Factor of National Power System
GFDL-CM2G	Global Circulation Model developed by the NOAA Geophysical Fluid Dynamics Laboratory GFDL-ESM2G
Gg	Gigagram (10^9 grams)
GHG	Greenhouse Gases
GIS	Geographic Information System
GPG	Good Practice Guidance
GISS-E2-H	Global Circulation Model developed by the NASA Goddard Institute for Space Studies
GISS-E2-R	Global Circulation Model developed by the NASA Goddard Institute for Space Studies
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GNI	Gross National Income
GoM	Government of the Republic of Moldova
GOST	Regional Standardization System used by the Euro-Asiatic Council for Standardization, Metrology and Certification
$GSE_{5, 10, 15^oC}$	End of Growing Season
GSL	Growing season length
$GSS_{5, 10, 15^oC}$	Start of Growing Season
GST	Growing Season Temperature
GSTI	Gas-Steam Turbine Installations
Gt	Gigatonne (10^9 tonnes)
GWP	Global-warming potential
h	Hour
ha	Hectare
HadGEM2-ES	Global Circulation Model developed by the Met Office Hadley Centre (additional HadGEM2-ES realizations contributed by Instituto Nacional de Pesquisas Espaciais)
H_2CO_3	Carbonic acid
HCl	Hydrochloric acid
HFC	Hydrofluorcarbons
HNO_3	Nitric acid
HP	Heat Plant
HR	Human Resources
H_2S	Hydrogen sulphide
HTC	Selianinov Hydrothermal Coefficient
JHA	Justice and Home Affairs
JJA	Summer Season: June, July, August
JICA	Japan International Cooperation Agency
JSC	Joint-Stock Company
Jul	July
Jun	June
	Angstrom Index
IAAE	International Agency for Atomic Energy
IBEC	Ivanov's Index of the Biological Effectiveness of the Climate
IBRD	International Bank for Reconstruction and Development
ICA	International Consultation and Analysis
ICAS	Institute for Forestry Research and Development
ICSID	International Centre for Settlement of Investment Disputes
ID	Ice days
IDA	International Development Association
IDC	International Development Cooperation
IE	Included Elsewhere
IE ASM	Power Institute of the Academy of Sciences of Moldova
IES	State Ecological Inspectorate
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFI	International Financial Institutions
ILO	International Labor Organization
IMF	International Monetary Fund
IMPACT	Emission Calculation Model, from ENPEP Software Package
IMW	Integrated Management of Waters
INDC	Intended Nationally Determined Contribution
INOGATE	Interstate Oil and Gas Transportation to Europe
INTAS	International Association for the promotion of cooperation with scientists from the independent states of the former Soviet Union
IOM	International Organization for Migration
IPA	Instrument for Pre-Accession Assistance
IPCC	Intergovernmental Panel for Climate Change
IPE ASM	Institute of Power Engineering of the Academy of Science of Moldova
IPNA	National Public Broadcasting Regulatory Agency
IPSL-CM5A-LR	Global Circulation Model developed by the Institute Pierre-Simon Laplace
IPSL-CM5A-MR	Global Circulation Model developed by the Institute Pierre-Simon Laplace
ITC	International Trade Center
ITTA	Innovation and Technology Transfer Agency
IWM	Integrated Water Management
JICA	Japan International Cooperation Agency
K^+	Ions of potassium

KC Key Categories
KfV Kreditanstalt Für Wiederaufbau / German Development Bank
kg Kilogram
kg c.c. Kilograms coal conventional
km Kilometer
km^2 Square kilometer
KMS Knowledge Management Strategy
KMP Knowledge Management Plan
kPa Kilopascal
kt Kiloton
kV Kilovolt
kW Kilowatt
kWh Kilowatt-hour
l Liter
L Level
LEAP Long Range Energy Alternatives Planning System
LECB Low Emission Capacity Building Programme
LEDS Low Emissions Development Strategy
LED Light-emitting diode
LFD Last Frost Day
$LGS_{5,\ 10,\ and\ 15^oC}$ Length of Growing Season
LNG Liquefied Petroleum Gases
LPA Local Public Authorities
LPG Liquefied Petroleum Gases
Ltd. Limited responsibility company
LU Land use
LULUCF Land Use, Land-Use Change and Forestry
LVI Livelihood Vulnerability Index
m Meter
m^2 Square meter
m^3 Cubic meter
MAED Model for Analysis of the Energy Demand
MAM Spring Season: March, April and May
Mar March
MARDE Ministry of Agriculture, Regional Development and Environment
MARCAL Market Allocation Model
Max Maximum
May May
MBT Mechanical-Biological Treatment
MCC Millennium Challenge Corporation
MCDA Multicriteria Decision Analysis Method
MCSFL Modelling Carbon Sequestration in Forested Landscapes
MD Moldova
MoD Ministry of Defense
MDB Multilateral Development Bank
MDG Millennium Development Goals
MDL Moldovan Lei
MEI Ministry of Economy and Infrastructure
MECR Ministry of Education, Culture and Research
MF Ministry of Finance
MFAEI Ministry of Foreign Affairs and European Integration
MJ Ministry of Justice
Mg^{++} Ions of magnesium
Mg Milligram
MHLSP Ministry of Health, Labor and Social Protection
MIA Ministry of Internal Affairs
mil. Million
Min Minimum
ml Milliliter
MLFSP Ministry of Labor, Family and Social Protection
MJ Megajoule (10^6 joule)
MIGA Multilateral Investment Guarantee Agency
MIROC5 Global Circulation Model developed by the Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology
M-K Mann-Kendall Test
mm Millimeters
MOP Meeting of the Parties to the Kyoto Protocol
MOST Moldovan Office for Science and Technology
MoSEFF Moldovan Sustainable Energy Financing Facility
MoREFF Moldovan Residential Energy Efficiency Financing Facility
MPI-ESM-LR Global Circulation Model developed by the Max Planck Institute for Meteorology
MPI-ESM-MR Global Circulation Model developed by the Max Planck Institute for Meteorology
MR Moldovan Railways
MRI-CGCM3 Global Circulation Model developed by the Meteorological Research Institute
MRV Monitoring, Reporting and Verification
MSU Moldova State University
Mt Megatonne (10^6 tons)
MTTP Moldovan Thermal Power Plant
MW Megawatt (10^6 watt)
Na^+ Ions of sodium
N_2O Nitrous oxide
NaOH Sodium Hydroxide
NA Not Applicable
NAER National Agency for Energy Regulation
NAMA National Appropriate Mitigation Actions
NAP National Adaptation Plan
NAPEE National Action Plan on Energy Efficiency
NATO North Atlantic Treaty Organization
NBM National Bank of Moldova
NBS National Bureau of Statistics
NCs National Communications
NC4 Fourth National Communication
NCCAS National Climate Change Adaptation Strategy
NCEFR National Commission for Environmental Fiscal Reform
NE Not Estimated
NECP National Energy Conservation Programme
NEEG Norwegian Energy Efficiency Group
NEET Normally Equivalent-Effective Temperature index
NEF National Environment Fund
NGEF National Grid Emission Factors

NGO	Non-Governmental Organization
NH_3	Ammonia
NH_4^+	Ammonium
NHDR	National Human Development Reports
NIF	Neighborhood Investment Facility
NIP	National Indicative Programme
NIR	National Inventory Report
NMVOC	Non Methane Volatile Organic Compounds
NO	Not Occurring
NO_x	Nitrogen Oxide
NO_3^-	Nitrate
NorESM1-M	Global Circulation Model developed by the Norwegian Climate Centre
NPAI	National Public Audiovisual Institution
NRS-UNFCCC	National Reporting System within UNFCCC
NSCE	Norwegian Society of Charted Engineers
NSPCPM	National Scientific and Practice Centre for Preventive Medicine
O_3	Tropospheric Ozone
OCT	October
ODA	Official Development Assistance
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substances
ODIMM	Organization for Small and Medium Enterprises Sector Development
OECD	Organization for Economic Cooperation and Development
OHCHR	Office of the High Commissioner for Human Rights
OPL	Overhead Power Line
OSCE	Organization for Security and Cooperation in Europe
OSME	Organization for Development of Small and Medium Enterprises
P	Precipitations
p-value	Indicates statistical significance of the trend
PC7	Seventh Framework Programme of the European Union
PDD	Project Document Design
PDN	Power Distribution Network
PE	Potential Evaporation
PFC	Perfluorcarbons
PIN	Project Identification Note
PJ	Petajoule (10^{15} joule)
PM10	10 µm fraction particulate matter
PPP	Purchasing Power Parity
PPPs	Private-Public Partnerships
POP	Persistent Organic Pollutants
ppb	Parts per billion of volume
ppm	Parts per million of volume
ppt	Parts per trillion of volume
PRCPTOT	Annual total wet day precipitation
PST	Pre-Service Training
q	Quintals
R	Daily average relative humidity
R^2	Coefficient of Determination
r	Pearson Correlation Coefficient
r_0	Free term
rr_1	Regression coefficient, trend coefficient
R10mm	Number of heavy precipitation days - number of days where daily precipitation amount ≥ 10 mm
R20mm	Number of very heavy precipitation days, where daily precipitation amount ≥ 20 mm
R95p	Very Wet Days
R95pTOT%	Contribution from Very Wet Days
R99p	Extremely Wet Days
R99pTOT%	Contribution from Extremely Wet Days
RBEC	UNDP Bratislava Regional Center
RCM	Regional Climate Model
RCP	Representative Concentration Pathway
REC	Regional Environment Center
RED	Electrical Distribution Networks
RES	Renewable Energy Source
REET	Radiation-Equivalent Effective Temperature index
RF	Radiative Forcing
RM	Republic of Moldova
RTEC	Chisinau Electrical Transport Administration
RX1day	Maximum One-Day Precipitation
RX5day	Maximum 5 Day Precipitation
s	Second
SAICM	Strategic Approach to International Chemicals Management
SAIP	State Agency for Intellectual Property
SAP	Sector Adaptation Plan
SAR	IPCC Second Assessment Report
SAUM	State Agrarian University of Moldova
SCSTD	Supreme Council for science and technological development
SDC	Swiss Agency for Development and Cooperation
SDII	Simple Daily Intensity Index
SE	State-Owned Enterprise
SEI	State Ecological Inspectorate
SEP	September
SEV	Specific Emissions Values
SF_6	Sulphur Hexafluoride
SGP	Small Grant Program
SHS	State Hydrometeorological Service
SIDA	Swedish International Development Cooperation Agency
SIGMA	Support for Improvement in Governance and Management
SME	Small and Medium Enterprises
SMS	Standardization and Metrology Service
SNC	Second National Communication
SO_2	Sulphur Dioxide
SON	Autumn Season: September, October, November
SPI	Standard Precipitation Index
SRES	IPCC Special Report on Emissions Scenarios
SREX	Special Report on Extreme Events
STDSC	Science and Technological Development Supreme Council
SU	Summer Days

SWOT	Analysis of Strengths, Weaknesses, Opportunities and Threats
$	Dollars
t	Tone
t	Mean Multiannual Temperature
T	Daily Average Air Temperature
T1	Tier 1
T2	Tier 2
TA	Technical assistance
T_{avg}	Mean Air Temperature
T_{max}	Maximal Air Temperature
T_{min}	Minimal Air Temperature
TACIS	Technical Aid to the Commonwealth of Independent States
TAIEX	Technical Assistance and Information Exchange
TAR	IPCC Third Assessment Report
t.c.e.	Tons of Coal Equivalent
TEMPUS	Trans-European Mobility Scheme for University Studies
TG	Teragram (10^{12} grams)
TJ	Terajoule (10^{12} joule)
TN10p	Cold Nights
TN90p	Warm Nights
TNC	Third National Communications of the Republic of Moldova under the UNFCCC
TNn	Minimum Daily Minimum Temperature each month
TNx	Maximum Daily Minimum Temperature each month
TNA	Technology Needs Assessment
TNC	Third National Communication
TR	Tropical Nights
TRACECA	Transport Corridor Europe-Caucasus-Asia
TUE	Total Updated Expenditures
TSU	Tiraspol State University
TTNM	Technology Transfer Network of Moldova
TUM	Technical University of Moldova
TX10p	Cold days
TX90p	Warm days
TXn	Minimum Daily Maximum Temperature each month
TXx	Maximum Daily Maximum Temperature each month
UCTE	Union pour la Coordination du Transport de l'Electricite
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFPA	United Nations Population Fund
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNCITRAL	United Nations Commission on International Trade Law
UNDAF	United Nations Development Action Framework
UNIDO	United Nations Program for Industrial Development
UNHCR	United Nations High Commissioner for Refugees
UNODC	United Nations Office on Drugs and Crime
USA	United States of America
USAID	United States Agency for International Development
US EPA	United States Environment Protection Agency
USD	$ US
USSR	Union of Soviet Socialist Republics
UTA	Autonomous Territorial Unit
VAT	Value Added Tax
WAM	With Additional Measures Scenario
WASP	Wien Automatic System Planning
WB	World Bank
WCAS	Worst-Case Alternative Scenario
WCRP	World Climate Research Programme
WG	Working Groups
WM	With Measures Scenario
WMO	World Meteorological Organization
WPP	Wind Power and Photovoltaic Plants
WPS	Wind Power Source
WSDI	Warm Spell Duration Index
x	Mean
X	Mean Annual Sum of Precipitation
Y_{pr}	Projected Value of the Average Annual Runoff
Z	Mann – Kendall Test
Σ	Sum
Δ	Difference
ΔP	Projected Total Season Precipitation Changes
ΔT	Projected Season Temperature Changes
σ	Standard Deviation
°	Degrees
⁰C	Celsius degrees
′	Seconds
%	Per cent
‰	Promile

CONTENTS



EXECUTIVE SUMMARY

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ES.1. Introduction

ES.1.1. Convention's Ultimate Objective

The ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) is aimed to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. To-date 196 countries are Parties to the Convention. Republic of Moldova signed the UNFCCC on June 12, 1992 and it was ratified by the Parliament on March 16, 1995.

Article 4, paragraph 1(a) and Article 12, paragraph 1(a) of the UNFCCC stipulate that each Party has to make available to the Conference of the Parties (COP) a "*national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be agreed upon by the Conference of the Parties; also a general description of steps taken or envisaged by the Party to implement the Convention; and any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including, if feasible, material relevant for calculations of global emission trends*".

ES.1.2. Reporting under the Convention

The main mechanism for making this information available is national communications. COP 2 (Geneva, 1996) adopted the Guidelines on national communications for Non-Annex I Parties (Decision 10/CP 2). In conformity with the respective Guidelines, during 1998 to 2000, under the *UNDP-GEF Project "Enabling Activities for the preparation of the First National Communication under the UNFCCC"*, Republic of Moldova developed its FNC to UNFCCC, submitted to the COP 6 (Hague, 2000).

The COP 8 (New Delhi, 2002) adopted a new Guideline on national communications for Non-Annex I Parties (Decision 17/CP 8). In conformity with these Guidelines, during 2005-2009 periods, under the *UNEP-GEF Project "Enabling Activities for the preparation of the Second National Communication under the UNFCCC"*, Republic of Moldova developed its SNC under the UNFCCC, within 2010-2013 period – the Third National Communication (TNC), while from 2014 to 2017, the Fourth National Communication (4thNC) was under preparation.

The COP 3 (Kyoto, 1997) adopted the Kyoto Protocol, representing an instrument setting binding targets for the Parties under Convention, by committing industrialized countries and economies in transition included in Annex I to Convention, to reduce total emissions of direct GHG by at least 5 per cent, against 1990 levels over the five-year period 2008-2012. The Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. As a Non-Annex I Party, the Republic of Moldova had no commitments to reduce GHG emissions under the first commitment period of the Kyoto Protocol.

In January 2010, the Republic of Moldova associated itself with the Copenhagen Accord and submitted an emissions reduction target that is specified in Annex II of this Agreement "National Appropriate Mitigation Actions in Developing Countries." The target of mitigation actions for Republic of Moldova under this Agreement is "*to reduce, to not less than 25% compared to the base year (1990), the total national level of greenhouse gas emissions by 2020, by implementing economic mechanisms focused on global climate change mitigation, in accordance with the principles and provisions of the Convention*". This target is presented without indicating specific national appropriate mitigation actions, identified and quantified, and without further clarification of the necessary support to achieve it. Simultaneously, it is recognized that achieving this target will require significant financial, technological and capacity-building support, which can be provided through the UNFCCC mechanisms.

The COP 18 (Doha, 2012) adopted the *Doha Amendment to the Kyoto Protocol* which establishes a second commitment period (January 1, 2013 – December 31, 2020) for the Parties included in Annex I to the Kyoto Protocol; adds a revised list of greenhouse gases to be reported; and a series of amendments to several articles of the Kyoto Protocol regarding the first commitment period. Under Doha Amendment, within the second commitment period, the developed countries should reduce their greenhouse gas emissions by at least 18 per cent compared to 1990 levels. By August 9, 2017, only 80 countries had ratified the Doha Amendment to the KP, most of which are Non-Annex I Parties to the UNFCCC and the KP.

At COP 19 (Warsaw, 2013), the Parties agreed to communicate their intended nationally determined contributions (INDC) (Decision 1/CP.19), in order to include them in the new Climate Agreement to be considered and adopted by the COP 21 in 2015, in Paris. It is expected that the new climate agreement will establish a new commitment period (1st of January 2021 – 31st of December 2030) for reducing the GHG emissions. Also, COP 19 adopted General guidelines for domestic measurement, reporting and verification of domestically supported nationally appropriate mitigation actions by developing country Parties (Decision 21/CP.19). This document provides a solid foundation for the new Climate Agreement 2015.

At COP 20 (Lima, 2014) the Parties agreed over Lima Call for Climate Action and were repeatedly invited to communicate to the Secretariat their intended nationally determined contributions, in order to facilitate clarity, transparency and understanding. The INDC may include, as appropriate, inter alia: (i) quantifiable information on the reference point; (ii) time frames and/or periods for implementation; (iii) scope and coverage; (iv) planning processes; (v) assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals; and (vi) how the Party considers that its national circumstances, and how it contributes towards achieving the objective of the Convention as set out in its Article 2.

According to Lima Call for Climate Action, countries were invited to communicate their intended nationally determined contributions by March 31, 2015, the deadline for the presentation being 1st of October 2015. The request to the Secretariat was to prepare by 1st of November 2015 a synthesis report on the aggregate effect of the INDC communicated by Parties. The Republic of Moldova is fully committed to the UNFCCC negotiation process towards adopting at COP 21 a Protocol, another legal instrument or an agreed outcome with legal force under the Convention, applicable to all Parties, in line with keeping global warming below 2°C by 2100 compared to the preindustrial era.

The Paris Agreement was signed by the Prime Minister of the Republic of Moldova in New York on September 21, 2016, and was subsequently ratified by the Parliament through Law No. 78 from 04.05.2017 for the ratification of the Paris Agreement (Official Monitor No. 162-170 from 26.05.2017).

At 25th of September 2015, the Republic of Moldova communicated its Intended Nationally Determined Contribution (INDC) and the accompanying information to facilitate clarity, transparency, and understanding, with reference to decisions 1/CP.19 and 1/CP.20. According to its INDC, the Republic of Moldova intends to achieve an economy-wide unconditional target of reducing its greenhouse gas emissions by 64-67 per cent below its 1990 level in 2030 and to make best efforts to reduce its emissions by 67 per cent. The reduction commitment expressed above could be increased up to 78 per cent below 1990 level conditional to, a global agreement addressing important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale commensurate to the challenge of global climate change. GHG emissions reduction targets have been set in an emission budget covering the period from January 1, 2021 to December 31, 2030. The GHG emission reduction targets set out in the national contribution intentionally determined of the Republic of Moldova were subsequently officially approved at national level by the Government Decision No. 1470 from 30.12.2016 regarding the approval of the Low Emissions Development Strategy of the Republic of Moldova by 2030 and the Action Plan for its implementation (Official Monitor No. 85-91 from 24.03.2017).

ES.2. National Circumstances

ES.2.1. Physical Context

Geographical location. Covering an area of 33,846 square km, Republic of Moldova is located in Central Europe, in the north-western Balkans. The country borders on Ukraine in the North, East and South and on Romania in the West, with the Western border line going along the river Prut. The Republic of Moldova is a Black Sea region country. Its southern border extends almost as far as the Black Sea coast, and the access to the Black Sea is open for the Republic of Moldova through the Dniester estuary and the Danube.

Relief. The relief of the Republic of Moldova is represented by hills and flatland areas, with uplands mostly in the central part of the country. The absolute altitudes are within the range of 429 m (Balanesti Hills) and 4 m above the sea level in the Dniester flood land (Palanca village).

Climate. The climate of the Republic of Moldova is moderately continental, characterized by relatively mild winters with little snow, long warm summers and low humidity. The average annual air temperatures vary between 6.3-12.3°C, and amount of precipitations, respectively between 307-960 mm per year.

ES.2.2. Natural Resources

Land Resources. Republic of Moldova has unique land resources characterized by predominant black earth soils (~75 per cent) with high productivity potential, very high utilization rate (>75 per cent); and rugged topography (above 80 per cent of the total arable land are located on hill slopes).

Water Resources. The hydrographical network accounts for circa 2.7 per cent of the country's territory and has a total length of circa 16 thousand km. The main rivers are Dniester and Prut, with a small opening to the Danube in the South. Moldova's hydrographical network density is 0.48 km per square kilometer on the average, varying between 0.84 km/km^2 in the northern regions and 0.12 km/km^2 in the regions on the left bank of the Dniester. There are approximately 60 natural lakes and more than 3.5 thousand water storage reservoirs. There are also about 6,200 boreholes and 250 thousand water-wells and springs, estimated at 1,811 thousand m^3/day.

Biological Resources. Currently the flora of the Republic of Moldova comprises about 5638 plant species (superior plants – 2014 species while inferior plants – 3624 species). The ecosystems which have the richest flora composition include: the forest (above 850 species), steppe (above 600 species), high-water basin (approximately 650 species), petrophyte (about 250 species), water and swamp (about 160 species) systems. The Republic of Moldova's fauna is relatively rich and manifold. There are above 15.0 thousand species of animals in the Republic of Moldova, including 461 species of vertebrates and above 14 thousand species of non-vertebrates. The vertebrates include 70 species of mammals, 281 bird species, 14 reptile species, 14 amphibian species and 82 fish species. Birds are highest in number among the vertebrates (281 species and subspecies), and insects - among non-vertebrates (above 12 thousand species). There are five natural reservations established for scientific research purposes (Codrii, Iagorlic, Padurea Domneasca, Plaiul Fagului, Prutul de Jos) with the total area of 19.2 thousand ha in the RM.

Mineral Resources. In the RM mineral resources are extracted from 415 deposits, the most important being limestone, granite, bentonite clay and sandy clay, diatomite, gypsum and chalk stone. Most of the minerals are extracted from open mines, and only certain limestone varieties are mined from stone quarries (underground galleries).

ES.2.3. Administrative-Territorial Organization, Population and Human Development

Administrative-Territorial Organization. The Republic of Moldova is administratively divided into 32 districts (Anenii Noi, Basarabeasca, Briceni, Cahul, Cantemir, Calarasi, Causeni, Cimislia, Criuleni, Donduseni, Drochia, Dubasari, Edinet, Falesti, Floresti, Glodeni, Hincesti, Ialoveni, Leova, Nisporeni, Ocnita, Orhei, Rezina, Riscani, Singerei, Soroca, Straseni, Soldanesti, Stefan Voda, Taraclia, Telenesti, Ungheni), 5 municipalities (Chisinau, Balti, Comrat, Tiraspol and Bender) and 2 administrative-territorial units: Administrative-Territorial Unit Gagauzia (ATU Gagauzia) and the administrative-territorial units on the left bank of the Dniester (ATULBD).

Population. As of 01.01.2016, the Republic of Moldova's population represented 4,030.3 thousand people, with the density of approximately 119.1 persons per square kilometer. Females prevail with 52.2 per cent in the nation's population - as opposed to 47.8 per cent of males in the total population. The majority of the population is concentrated in the rural areas. The existing 1,614 rural settlements have 2,190.4 thousand residents or 54.3 per cent of the total population, on average circa 1,400 residents per settlement. The urban population is 1,839.9 thousand residents or 45.7 per cent, on average circa 27 thousand residents per settlement. According to the data of the latest 2014 population census (held separately in the areas on the right bank of the Dniester and in the administrative-territorial units on the left bank of the Dniester), Moldovans/ Romanians accounted for about – 73.1 per cent, Ukrainians – 8.8 per cent, Russians – 7.6 per cent, Gagauz – 4.0 per cent, Bulgarians – 1.9 per cent, Gypsies – 0.3 per cent, Jews – 0.7 per cent and other nationalities – 3.5 per cent.

Demographic situation. During 1990-2016 the demographic processes featured a negative development pattern, which showed itself in the general instability of demographic indicators and phenomena such as: falling birth rate, growing mortality, demographic ageing, depopulation and others. In 2016, the birth rate was 10.5‰ (17.7‰ in 1990), slightly lower the mortality rate (10.8‰ in 2016, respectively 9.7‰ in 1990); the infant mortality rate was 9.4‰ (19.0‰ in 1990); the share of population aged under 15 decreased down to 17.0 per cent (27.9 per cent in 1990), and the age group of persons above 57/62 years increased to 18.5 per cent (12.6 per cent in 1990); the 'average life expectancy at birth' indicator represented circa 72.2 years (68.0 years in 1990), of which 68.1 years for males (63.9 years in 1990) and 76.2 years for females (71.9 years in 1990).

Public Health. By the end of 2015 the health facilities network in the Republic of Moldova included: 85 hospitals, 1,029 medical facilities of ambulatory or polyclinic type, 42 sanitary-epidemiological facilities, 139 emergency stations and posts, three children homes and two tuberculosis sanatoriums. The number of beds in hospitals represented circa 28.803 thousand or 52.9 beds per 10,000 populations; respectively, the total number of doctors was – 13.012 thousand or 36.6 doctors per 10,000 populations. Over the period from 1990 to 2015 the overall mortality rate tended to increase. The mortality breakdown analysis for 2015 has demonstrated that cardiovascular pathologies are still the main cause of death (57.7 per cent), followed by tumors (15.1 per cent), intestinal diseases (9.4 per cent), injuries, poisoning and other consequences of external causes (6.9 per cent) and respiratory diseases (4.6 per cent). The mortality rates by region are not uniform, registering dramatic differences between the regions: the lowest mortality rates were reported in urban areas (the municipality of Chisinau and in Balti), whereas the highest rates in northern and central districts (Donduseni, Briceni, Edinet, Drochia, Riscani, Floresti, Glodeni, Ocnita, Soldanesti and Rezina).

Between 2010 and 2016, the health care expenditures from public sources represented 5.6 per cent (2010) – 5.1 per cent (2016) from the GDP. Even if in nominal terms the amounts allocated for this sector increased (3.997 billion MDL in 2010, respectively 6.756 billion MDL in 2016), in real terms these have an oscillatory trend, for 2015 and 2016 being even a negative one. Consequently, in 2015, Republic of Moldova was one of the last countries in Europe regarding the share of public spending in total health spending. Respectively, the country's population has to compensate this deficit using its own resources in order to access healthcare services. At the same time, the pocket payments indicator is around 48 per cent of the total health spending, with no prospects for improvement over the next period[1].

Educational System. The Ministry of Education, Culture and Research, the Municipal Education Departments, Regional General Departments of Education and Educational Establishments are responsible for the delivery of the primary, secondary general, secondary professional, secondary vocational and university education. At the beginning of the 2016-2017, school year the RM had 1,291 operating primary and secondary general educational establishments, 43 secondary professional educational establishments, 43 secondary vocational education establishments (colleges), and 30 higher education establishments (post graduate studies for a doctoral degree being provided in 43 scientific research institutes and higher education establishments).

The share of education within the GDP is continuously decreasing starting with 2009, when it reached its highest level of 9.4 per cent. Still, the expenditures for education from the State Budget are growing, for 2015 representing 8.5672 billion MDL by 0.7436 billion MDL more than in 2014, thus accounting for 7.2 per cent of the GDP[2].

ES.2.4. Institutional Arrangements

Institutional Arrangements Relevant for the Preparation of the National Communications and Biennial Update Reports. On behalf of the Government of the Republic of Moldova, the Ministry of Agriculture, Regional Development and Environment (MARDE) is responsible for the implementation of international environment treaties to which RM is a Part (including the UNFCCC). Representatives of the MARDE also perform the function of the UNFCCC Focal Point. The Climate Change Office under the MARDE is totally responsible for the activities related to preparation of National Communications, Biennial Update Reports, National Inventory Reports and GHG Inventories.

ES.2.5. Economical Context

Gross Domestic Product. In 2016, the share of industry sector in the GDP structure was 15.1 per cent, the agriculture – 12.2 per cent, transport and communications – 10.8 per cent, constructions – 3.3 per cent, wholesale and retail trade – 14.3 per cent, financial activities – 5.4 per cent, other sectors – 25.6 per cent, net product and import taxes – 14.8 per cent.

The country's economy was in decline even before 1991, but the separation from the USSR has accelerated that process considerably. Gross Domestic Product levels were decreasing continuously during the period from 1990 to 1999 inclusively, when it fell down to as little as 34 per cent of the 1990 level. The only exception was year 1997, when a slight increase by 1.6 per cent versus the previous year was registered due to the excellent agricultural yields as result of the very favorable weather. The reasons for the economic collapse were multiple. First, the Republic of Moldova had been integrated completely in the USSR economic system, and the independence resulted, among other things, in the cessation of any subsidies or cash transfers from the centralized government. Second, the end of the Soviet Era with its well established commercial links has resulted in the emergence of multiple obstacles for free

[1] Dumitru Pântea, Ion Gumene (2016), Analiza cheltuielilor destinate ocrotirii sănătății în Republica Moldova. Expert-Grup, Centru Analitic Independent. Chişinău, Octombrie 2016. p. 26.
[2] Victoria Vasilescu (2015), Prevederile bugetului public național pentru 2015 în educație (notă analitică). Expert-Grup, Centru Analitic Independent. Chişinău, Mai 2015. p. 6.

movement of products, and in access restrictions introduced by the emerging markets. Third, the lack of domestic energy resources and raw materials in the RM has contributed considerably to the nation's strong dependence on other former Soviet Republics. Certain internal reasons should be mentioned as well, such as: transition from a centralized economy to a market economy; loss of the industries located in Transnistria; frequent droughts; and the civil conflict. The considerable GDP growth achieved since 2000 seems to indicate that the economy is finally developing in the correct direction, although it should be remembered that in 2016 the GDP reached only 72.1 per cent of the 1990 level (Figure ES-1).

Inflation. The inflation rate grew dramatically up to approximately 788.5 per cent in 1993 and slowed down to 7.7 per cent in 1998. The 1998 depreciation of the Russian Rubble caused rapid growth of the inflation up to 39.3 per cent. Later, the RM achieved a significant progress in terms of controlling its inflation rate, and the inflation rate decreased to 5.2 per cent in 2002; however, the 2003 average inflation rate for the year increased up to 11.7 per cent driven by the growing prices for agricultural products (as result of a severe drought), and the above growth pattern persisted in the subsequent years; the inflation reached 12.4 per cent in 2004, but decreased to 11.9 per cent in 2005 – only to grow up to 12.7 per cent in 2006, in particular due to the increased prices for the natural gas imported from Russian Federation, for fuels and medications. The average inflation rate for the year was about 12.4 per cent in 2007 and 12.7 per cent in 2008. This increase was determined by the growing prices for public utilities, increasing food demand and the growth of the purchasing power. In 2009, the inflation rate represented about 0.006 per cent, increasing up to 7.4 per cent in 2010 and to 7.6 per cent in 2011, in particular, due to the more evident growth of food and fuels prices, and partly being influenced by developments in the foreign exchange markets. Between 2012 and 2013, the risk balance continued to be influenced by external and internal factors, with a slight emphasizes on post-inflationary factors. In 2014, the inflation rate was 5.1 per cent, which is by 0.5 percentage points higher compared to the previous year. In 2015, the annual average inflation rate accounted for 9.7 per cent, by 4.6 percentage points higher compared to the previous year. In 2016, it represented 6.4 per cent, significantly less than in 2015. The decreasing trend was partly due to modest domestic demand, the high level of the base period in 2015, and a rich harvest that favored the decline in food prices. At the same time, the downward trajectory of inflation was also supported by a decrease in regulated price pressures as a result of lowering of the gas and electricity tariff in the first part of the year but also due to the gradual dissipation of the impact of tariff increase for the electricity in the summer of 2015.

Trade Balance Deficit. Moldova's import expenses exceed considerably the nation's proceeds from its exports, thus indicating a serious problem in terms of the nation's trade balance deficit. That deficit increased from 24.0 per cent of the GDP in 2000, up to 29.3 per cent of the GDP in 2016. The above reflects the nation's dependence on the imports of energy resources and the growing demand for the imported products. The imports growth is driven by the massive inflow of cash transfers from abroad, which are channeled in domestic consumption.

Cash Transfers and Remittances. Cash transfers from outside the country, and in particular cash inflows from the Moldovans working abroad accounted for circa 1.4649 billion USD or circa 21.7 per cent of the GDP, being of major importance for the economy of the Republic of Moldova. Globally, the RM is among the leaders regarding the share of remittances in GDP.

Investments. Investments play an essential role in the economic growth of the country, increasing significantly over the last years. In 2016, investments in the national economy represented about 19.406 billion MDL, equivalent of USD

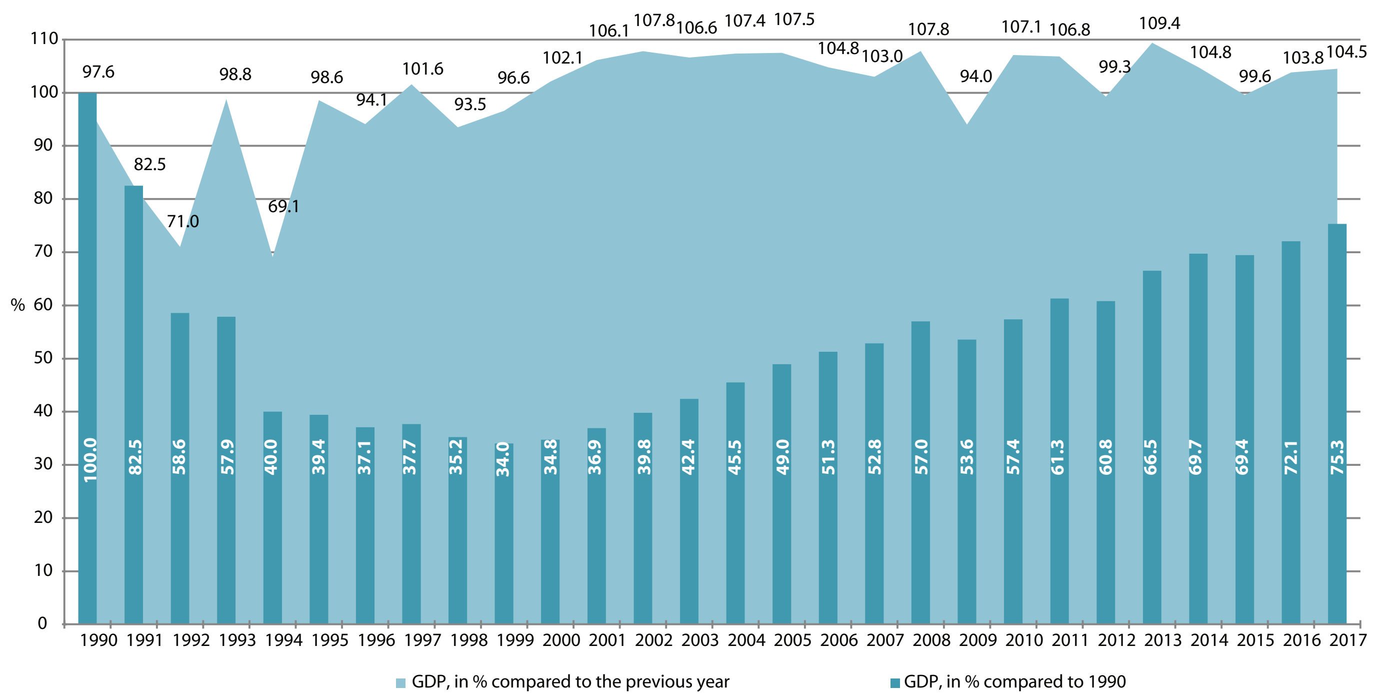


Figure ES-1: Gross Domestic Product in the Republic of Moldova during 1990-2017 periods, in % compared to 1990 and respectively, to the previous year

0.974 billion (14.4 per cent of the GDP). At the same time, in 2016 the direct foreign investments attracted to the national economy (net values) accounted for USD 124.4 million (1.8 per cent of the GDP), much less compared to 2008, when these accounted for USD 726.6 million (12.0 per cent of the GDP). The top investor countries for the Republic of Moldova include: the Netherlands, Russian Federation, Spain, USA, Germany, Romania, France, UK and Turkey. The international investment position of the country, as of 31.12.2016, remained net debtor and accounted -5.979 billion USD, with the negative balance increasing towards the end of 2015 by 7.0 per cent. The stock of liabilities to foreign direct investments represented USD 3.58 billion (an increase by 3.3 per cent from the beginning of the year) and accounted for 38.2 per cent of the total. During 2016, the stock of official reserve assets was reassured, thus, as from 31.12.2016, this stock exceeded the level recorded at the end of 2014, increasing by 25.6 per cent compared to the end of 2015 and accounting for USD 2.21 billion. The country's gross external debt as of December 31, 2016 recorded USD 6.59 billion, increasing over the year 2016 by 3.3 per cent.

Social Sphere. In 2016, the average monthly salary of an employee in the national economy was 5084.0 MDL, a 10.3 per cent increase compared to the same period of 2015, while in real terms (adjusted to the consumer price index) – by 3.7 per cent. As of January 1, 2017, the average monthly old-age pension was 1275.2 MDL, increasing by 9.4 per cent compared to its level as of January 1, 2016. The number of pensioners registered by the social security authorities as of January 1, 2017, represented 691.2 thousand people, with 11.3 thousand more compared to January 1, 2016. The 2016 unemployment, estimated according to the standards of the International Labor Organization (ILO), was 53.3 thousand people. The unemployment rate (unemployed persons as a percentage of the total economically active population) recorded at the country level represents 4.2 per cent -5.5 per cent for males and 2.9 per cent for females.

ES.2.6. Current State of the National Economy

Industry. In 2016, the industrial production reached circa 59.9 per cent of the 1990 level (Figure ES-2). During 1990-2016 the industrial production featured certain fluctuations, showing the best performance between 2001 and 2003, and the worst performance in 1992, 1994, 1998, 1999 and 2009. The situation in the manufacturing industry was determined mainly by the processing industry which account for 87.6 per cent of the total production of the large enterprises whose main business was manufacturing. Food and drinks industry accounted for the highest share in the processing industry performance (processing and canning of meat and meat products, fruit and vegetables, production of dairy products, pastry; fodder, bread and baked products, confectionary, sugar, cocoa, chocolate, confectionary, alcoholic drinks, wine, beer, etc.) as well as production of other products of non-ferrous minerals (manufacturing of glass and glass products; fritted bricks and tiles; cement; lime; gypsum and concrete elements).

Energy. Total energy consumption in 2015 in the RM accounted for as little as circa 21.2 per cent compared to 1990 (electricity consumption – 47.7 per cent, and heat consumption, respectively circa 16.6 per cent). The main power generation facilities in the RM are: Moldovan Thermal Power Plant (MTPP) in Dnestrovsk (ATULBD) with the installed capacity of 2520 MW (available output of around 950 MW); Combined Heat Power Plant No. 1 (CHP-1) in Chisinau with the installed electricity generation capacity of 46 MW (available output of about 40 MW) and installed heat generation capacity of 455 MW; Combined Heat Power Plant No. 2 (CHP-2) in Chisinau with the installed electricity generation capacity of 240 MW (available output of around 210 MW) and installed heat generation capacity of 1425 MW; Combined Heat Power Plant North (CHP-North) in Balti with the installed electricity generation capacity of 28.5 MW (available output of about 24 MW) and installed heat generation capacity of 610 MW; CHPs of the sugar mills with the total installed capacity of 98 MW (available output of around 20 MW), Dubasari Hydro-Power Plant (HPP) with the installed capacity of 48 MW (available output of about 30 MW) and Costesti HPP with the installed capacity of 16 MW (available output of about 10 MW).

Agriculture. In 2016, the agriculture production by all categories of producers accounted for only 71.1 per cent of the 1990 level (Figure ES-2). Between 1991 and 2016, the agricultural production was characterized by fluctuations, with the best performance reported in 1993, 1997, 2004, 2008, 2013 and 2016, and with poor results – respectively in 1992, 1994, 1996, 1998, 2003, 2007, 2012 and 2015, in most cases being caused by unfavorable climate conditions (severe droughts in 2003, 2007, 2012 and 2015). Compared to 1990, the amount of synthetic and organic fertilizer applied to soil has reduced significantly: in 2015, 52.4 kt of synthetic fertilizers and 61 kt of organic fertilizers were applied or by 77.5 per cent and respectively 99.4 per cent less than in 1990 (232.4 kt of synthetic fertilizers and 9.74 million tons of organic fertilizers). Also, the number of domestic livestock and poultry has reduced considerably compared to 1990 (standing by the end of the year): cattle – by 80.7 per cent (1060.7 thousand in 1990, 204.5 thousand in 2015), sheep – by 41.5 per cent (1244.8 thousand in 1990, 728.7 thousand in 2015), swine – by 73.8 per cent (1850.1 thousand in 1990, 484.5 thousand in 2015) and poultry of all categories – by 55.3 per cent (24.625 mill. in 1990, 12.429 mill. in 2015), horses – by 15.0 per cent (47.2 thousand in 1990, 40.2 thousand in 2015); at the same time, during the period under review it was reported an increase regarding other species such as: goats – by 4.1 times (37.1 thousand in 1990, 152.1 thousand in 2015), rabbits – by 23.7 per cent (283.0 thousand in 1990, 350.2 thousand in 2015) and asses and mules – by 16.0 per cent (1.7 thousand in 1990, 2.0 thousand in 2015).

Transport. RM's transport sector is comprised of the following segments: road transportation, railway transport, air transportation and naval transportation. The national network of roads has a total length of 10897 km (including 9386 km – on the right bank of Dniester, 1511 km – on the left bank of Dniester; hard surface roads: 8894 km – on the right bank of Dniester and 1470 km – on the left bank of Dniester). The network of roads is sufficiently developed (the public roads density represents about 322 km/1000 km^2, while the hard-

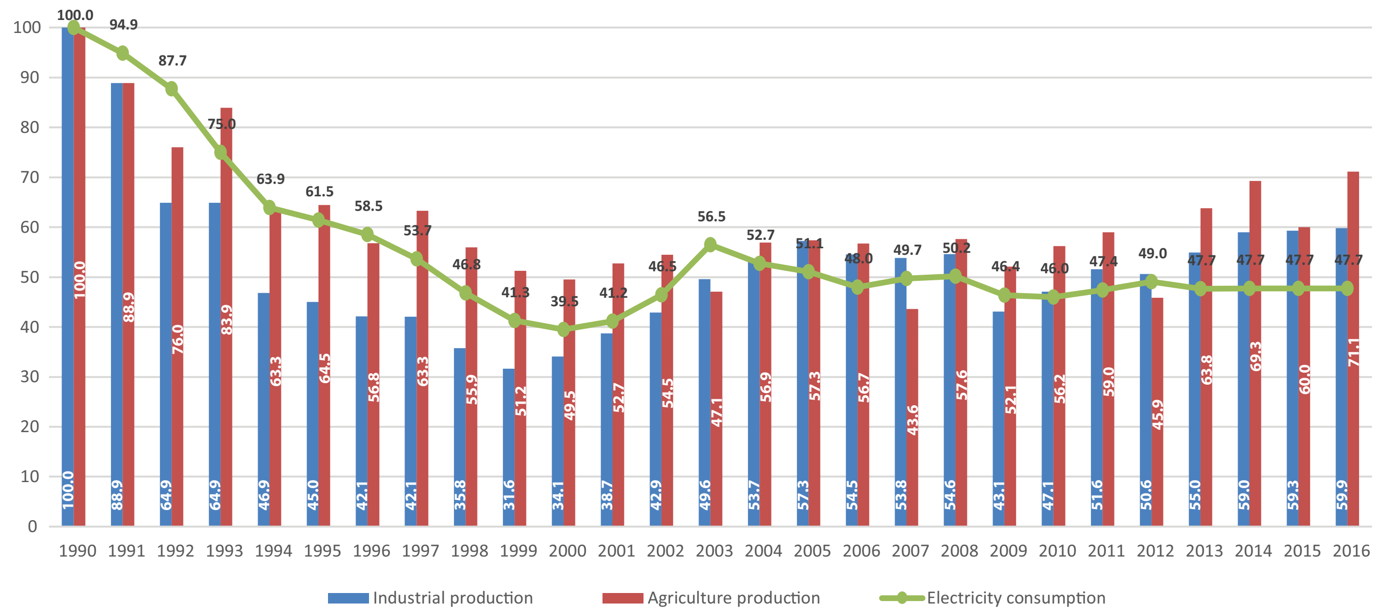


Figure ES-2: The main economic indicators of the Republic of Moldova during 1990-2016 periods, in % compared to 1990

surface roads - circa 306 km/1000 km[2]), but the state of the roads and the infrastructure in general is deplorable, though in the last six years repairs and restoration of the national road network are being widely performed. Between 1990 and 2016 the number of road vehicles in the RM has significantly increased: trucks - by 119.7 per cent (from 76.909 thousand to 168.963 thousand), buses and minibuses - by 89.3 per cent (from 11.305 thousand to 21.399 thousand) and cars - by 213.0 per cent (from 208.984 thousand to 654.108 thousand). The history of railway transportation dates back 140 years. The total length of railway lines is 1157 km, while the density per 1,000 km[2] is 34 km. RM's river transport is in the process of development and growth in terms of both the number of ships and the number of river ports. The length of waterways for general use is currently about 624 km (including 558 km on the right bank of Dniester, respectively 66 km on the left bank of Dniester). There are 4 airports in the RM: in Chisinau, Balti, Cahul and Marculesti, of which only the Chisinau airport offers regular scheduled flights. The airports in Cahul and Marculesti are still in the process of obtaining the required statutory approvals and certificates. The Balti Airport is certified, but it offers only charter flights. In comparison with 1990 the freight transportation has reduced considerably both in terms of the freight transportation turnover (by 88.8 per cent: from 331.1 mill. tons in 1990, to 37.0 mill. tons in 2016), as well as freight transportation distance (by 74.7 per cent: from 21,648 mill. tons - km in 1990, to 5484 mill. tons-km in 2016). The same period witnessed the significant reduction in number of passengers (by 66.7 per cent: from 757.7 mill. passengers in 1990 to 252.0 mill. passengers in 2016), as well as in passenger transportation distance (by 46.6 per cent: from 10,102 mill. passengers - km in 1990, to 5397 mill. passengers - km in 2016).

ES.3. National Greenhouse Gases Inventory

ES.3.1. Republic of Moldova's Relative Contribution to Global Warming

The Republic of Moldova historic contribution to global warming is low. In 2015, the country contributed with circa 13.95 Mt CO_2 equivalent (without LULUCF) and 11.11 Mt CO_2 equivalent (with LULUCF), representing less than 0.04 per cent of total global GHG emissions. Total and net emissions per capita, respectively, were less than half of the global average (3.5 t CO_2 equivalent per capita compared to 6.4 t CO_2 equivalent per capita, respectively 2.8 t CO_2 equivalent per capita compared to 6.8 t CO_2 equivalent per capita). Also, the RM's share in global GHG emissions recorded since 1990 is low, under 0.05 per cent (without LULUCF) and less than 0.04 per cent (with LULUCF). Within 1990-2015 periods, total GHG emissions decreased by circa 67.8 per cent: from 43.40 to 13.95 Mt CO_2 equivalent.

ES.3.2. Institutional Arrangements for Inventory Preparation

Within the Ministry of Agriculture, Regional Development and Environment (MARDE), the Climate Change Office (CCO) is totally responsible for the activities related to preparation of National Communications (NCs), Biennial Update Reports (BURs), National Inventory Reports (NIRs) and National GHG Emission Inventory Reports.

ES.3.3. Methodological Issues

The national inventory is structured to match the reporting requirement of the UNFCCC and is divided into five main sectors, and each of these sectors is further subdivided, within the inventory, by source categories. Emissions of direct (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) (no NF_3 emissions have been registered in the Republic of Moldova so far) greenhouse gases were estimated based on methodologies contained in the 2006 IPCC Guidelines, while the indirect emissions (NOx, CO, NMVOC and SO_2) were estimated based on methodologies according to the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), respectively according to the EEA/EMEP Air Pollutant Emission Inventory Guidebook (2016).

ES.3.4. Key Categories

In order to prioritize efforts aimed at improving the overall quality of the inventory, based on recommendations set forth in the 2006 IPCC Guidelines, the key categories were identified for the time series 1990 through 2015, without LULUCF – based on the Tier 1 methodological approach, 16 key categories by level (L) and 16 key categories by trend (T); based on a Tier 2 approach – 14 key categories by level (L) and 12 key categories by trend (T); with LULUCF – based on the Tier 1 methodological approach – 20 key categories by level (L) and 16 key categories by trend (T); based on a Tier 2 approach – 19 key categories by level (L) and 14 key categories by trend (T).

ES.3.5. Quality Assurance and Quality Control

The basic Quality Assurance (QA) and Quality Control (QC) activities carried out in the Republic of Moldova included detailed specific procedures implied by Tier 1 approach (general procedures) and Tier 2 approach (source-specific), and standard verification and quality control forms and checklists that serve to standardize the process of implementing quality assurance and quality control activities meant to ensure the quality of the national inventory; technical review (audit) carried out by experts who were not directly involved in the national inventory compilation/ development process; activity data quality check, including by comparing data obtained from different sources, as well as further documentation of the national inventory development process. As the entity responsible for the national inventory development, the Climate Change Office holds all documentation used for inventory compilation.

ES.3.6. Recalculations

The national inventory team revised and recalculated GHG emissions and CO_2 removals for each calendar year covered by the inventory for the period from 1990 through 2013, a component part of the BUR1 of the Republic of Moldova under the UNFCCC (2016). These activities were carried out during the on-going process of improving the quality of the National GHG Inventory (including, by taking into account the updated activity data, new methodological approaches available in the 2006 IPCC Guidelines [the complete transition to this Guidelines has been achieved in the current inventory cycle], emission factors used, and identified errors correcting actions). In comparison with the results reported under the BUR1, the changes made during the development of the current inventory, resulted in insignificant increased values of total direct GHG emissions in 1991 and 1994-2012, respectively revealed a decreasing trend in 1990, 1992-1993 and 2013.

ES.3.7. Uncertainty Assessment

In the Republic of Moldova, the GHG emissions were estimated with the highest possible accuracy; however, the obtained results have a certain degree of uncertainty. Some emissions estimates, such as for example, CO_2 emissions from fossil fuels combustion, or CO_2 emissions from cement production, are considered to have minimal uncertainty. For other source categories, because of the poor quality of activity data, the use of default emission factors, as well as a consequence of limited understanding of the emissions generation process, the uncertainty is quite high. The overall inventory uncertainty was estimated for the period 1990-2015 using a Tier 1 methodological approach, that is ±8.45 per cent uncertainty by level, and ±2.37 per cent uncertainty by trend.

ES.3.8. Completeness Assessment

Generally speaking, the national inventory of the Republic of Moldova is a complete register of the following direct greenhouse gases – CO_2, CH_4, N_2O, HFC, PFC and SF_6. The national inventory also covers the following indirect greenhouse gases: CO, NO_x, NMVOC and SO_2. Despite the effort to cover all existent source/sink categories, the inventory still has some gaps, most being determined by lack of activity data needed to estimate certain GHG emissions and removals.

ES.3.9. Reporting Direct Greenhouse Gas Emissions

Carbon dioxide continues to contribute most to the total national direct GHG emissions in the Republic of Moldova (Figure ES-3).

Within 1990 to 2015 periods, the total CO_2 emissions (without LULUCF) decreased by circa 73.1 per cent (from 34.8952 Mt in 1990 to 9.3956 Mt in 2015). CH_4 and N_2O emissions decreased by circa 49.8 per cent (from 5.7036 Mt CO_2 equivalent in 1990 to 2.8627 Mt CO_2 equivalent in 2015), respectively by 45.9 per cent (from 2.8013 Mt CO_2 equivalent in 1990 to 1.5145 Mt CO_2 equivalent in 2015) (Table ES-1). Evolution of F-gases denotes a steady trend towards increase in the last years, though their share in the total national emissions structure is insignificant for now.

Energy Sector is the most important source of total national direct GHG emissions, its share varying over the time series from 1990 through 2015 from 79.8 per cent and 68.1 per cent. Other relevant sources are represented by Agriculture, Waste

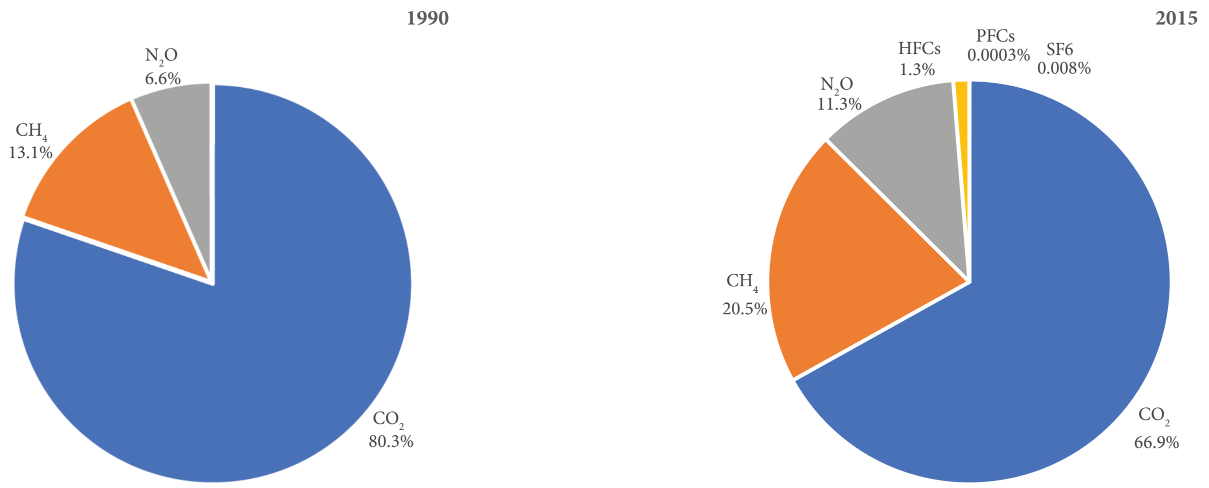


Figure ES-3: Republic of Moldova's Direct GHG Emissions by Gas, 1990 and 2015

Table ES-1: Direct GHG Emissions in the Republic of Moldova within 1990-2015, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 (without LULUCF)	34.8952	31.0359	21.3191	16.0959	14.9803	11.5887	11.7678	10.7194	9.1852
CO_2 (with LULUCF)	29.0128	23.3966	14.2115	8.8982	8.5721	5.0373	5.4717	4.5634	2.9740
CH_4 (without LULUCF)	5.7036	5.2873	4.8574	4.5944	4.4237	4.1673	4.0936	3.7181	3.5328
CH_4 (with LULUCF)	5.7063	5.2897	4.8596	4.5974	4.4254	4.1695	4.0952	3.7208	3.5352
N_2O (without LULUCF)	2.8013	2.6646	2.2085	2.2483	1.7987	1.8892	1.8457	1.8593	1.6807
N_2O (with LULUCF)	2.8614	2.7241	2.2625	2.3064	1.8597	1.9563	1.9140	1.9239	1.7480
HFCs	NO	NO	NO	NO	NO	0.0046	0.0052	0.0060	0.0075
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	43.4000	38.9878	28.3850	22.9386	21.2027	17.6498	17.7123	16.3028	14.4061
Total (with LULUCF)	37.5804	31.4104	21.3336	15.8020	14.8571	11.1677	11.4861	10.2141	8.2647
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2 (without LULUCF)	7.2033	6.4504	7.0595	6.7827	7.4863	8.0163	8.3850	7.7398	8.1264
CO_2 (with LULUCF)	1.0176	0.3199	1.1837	1.8325	2.4732	4.0463	3.5447	2.6378	3.0328
CH_4 (without LULUCF)	3.3915	3.3209	3.3225	3.3681	3.2940	3.2622	3.3030	3.1688	2.9971
CH_4 (with LULUCF)	3.3939	3.3219	3.3237	3.3684	3.2940	3.2624	3.3032	3.1691	2.9988
N_2O (without LULUCF)	1.5195	1.4260	1.5813	1.6343	1.4182	1.6621	1.6839	1.5989	1.0149
N_2O (with LULUCF)	1.5906	1.4985	1.6631	1.7173	1.5039	1.7472	1.7596	1.6651	1.0826
HFCs	0.0086	0.0105	0.0129	0.0169	0.0237	0.0311	0.0422	0.0547	0.0698
PFCs	NO	NO	NO	NO	NO	NO	NO	0.0000	0.0000
SF_6	NO	NO	NO	NO	0.0000	0.0000	0.0001	0.0003	0.0004
Total (without LULUCF)	12.1228	11.2078	11.9762	11.8020	12.2221	12.9717	13.4141	12.5625	12.2087
Total (with LULUCF)	6.0108	5.1507	6.1833	6.9351	7.2948	9.0870	8.6497	7.5270	7.1845
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
CO_2 (without LULUCF)	8.7930	9.0898	9.6570	9.8288	9.5065	8.4882	9.2609	9.3956	-73.1
CO_2 (with LULUCF)	4.2377	5.1696	6.3596	7.1157	6.4892	5.8716	6.5376	6.4910	-77.6
CH_4 (without LULUCF)	2.9837	2.8913	2.9134	2.9767	2.9285	2.8710	2.9367	2.8627	-49.8
CH_4 (with LULUCF)	2.9844	2.8917	2.9136	2.9769	2.9298	2.8719	2.9368	2.8634	-49.8
N_2O (without LULUCF)	1.6066	1.3994	1.5789	1.5772	1.1839	1.6509	1.8494	1.5145	-45.9
N_2O (with LULUCF)	1.6735	1.4671	1.6461	1.6461	1.2548	1.7196	1.9115	1.5730	-45.0
HFCs	0.0847	0.0932	0.1134	0.1195	0.1288	0.1376	0.1514	0.1794	NA
PFCs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	NA
SF_6	0.0005	0.0006	0.0007	0.0007	0.0008	0.0010	0.0011	0.0011	NA
Total (without LULUCF)	13.4685	13.4743	14.2635	14.5031	13.7486	11.4349	14.1995	13.9533	-67.8
Total (with LULUCF)	8.9809	9.6222	11.0334	11.8591	10.8034	8.8878	11.5384	11.1079	-70.4

Abbreviations: NA – Not Applicable; NO – Not Occurring

and IPPU Sectors (Figure ES-4). During the entire period under review, the LULUCF Sector represented a net source of carbon removals. With the decrease of national direct GHG emissions, the importance of this sector in the structure of net GHG emissions at the national level increased significantly: in 1990 – the removals represented only circa 13.4 per cent of the total national GHG emissions, while in 2015 it represented already circa 20.4 per cent of the total.

Within 1990-2015 periods, total GHG emissions in the Republic of Moldova tended to decrease, thus emissions under Energy Sector decreased by circa 72.6 per cent, Industrial Processes and Product Use – by circa 49.7 per cent, Agriculture – by 59.4 per cent, LULUCF – by 51.1 per cent, while from Waste Sector – by 22.2 per cent (Table ES-2).

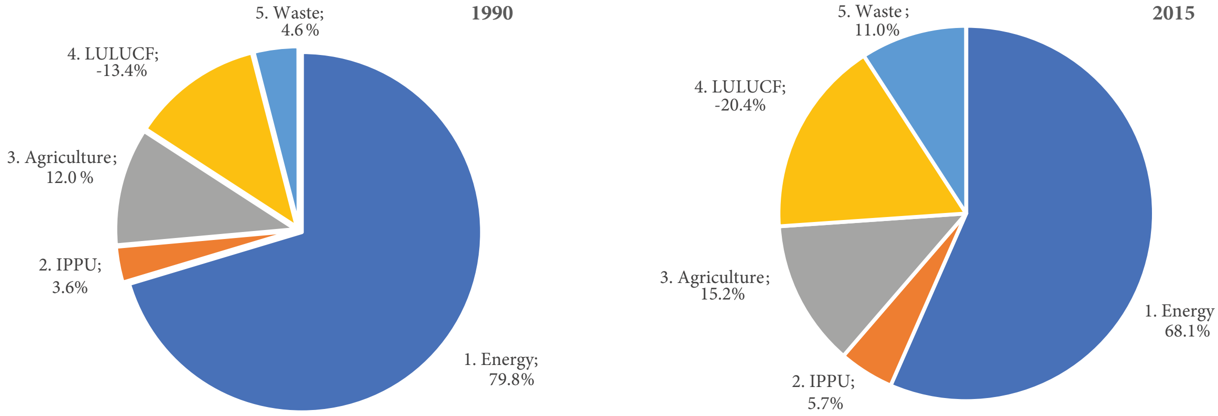


Figure ES-4: Sectoral Breakdown of the Republic of Moldova's total GHG Emissions in 1990 and 2015

ES.3.10. Emission Trends for Ozone and Aerosol Precursors

Though not considered greenhouse gases, photochemically active gases like carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC), have an indirect global warming effect. These gases are considered as ozone precursors influencing the formation and destruction of tropospheric and stratospheric ozone. In particular, they are emitted from transportation, fossil fuel combustion, consumption of solvents and other household products, etc. Thus, the national GHG inventory of the Republic of Moldova includes emissions of the following ozone and aerosol precursors: NOx, CO, NMVOC and SO_2. Between 1990 and 2015, total nitrogen oxides emissions decreased by circa 68.5 per cent; total carbon monoxide emissions decreased by circa 61.5 per cent; non-methane volatile organic compounds emissions - by circa 61.6 per cent; while sulphur dioxide emissions - by circa 92.6 per cent (Table ES-3).

ES.4. Climate Change Mitigation Policies and Measures

The National Development Strategy "Moldova 2020" sets out eight priorities of the country. Despite the fact that neither of these priorities looks at climate change, many of them are directly related to greenhouse gas emissions reduction. At the same time, understanding the importance of climate change mitigation, the Government has decided that the latter should be addressed through a separate strategy. Thus, on 30 December 2016, for the first time, the Republic of Moldova approved the Low Emission Development Strategy (LEDS) of the Republic of Moldova until 2030. The Strategy strengthens and guides the sector development approach that sets the country's long-term climate change mitigation objectives and strategy.

The overall goal of the Strategy is consistent with the one set forth in the Intended Nationally Determined Contribution (INDC) paper for the Paris Agreement. According to the latter, by the year 2030 the RM commits to achieve the unconditional target of 64-67% GHG emissions reduction versus the baseline year (1990), and 78% as a conditional target for the same period.

The overall goal is supported by intermediate targets established for the years 2020 and 2025, including by sectors. Intermediate targets provide for reducing total national GHG emissions by no less than 65% (by 2020) and, respectively, 69% (by 2025), compared to the 1990 level.

Effectively, the LEDS strengthens the objectives related to GHG emissions reductions, stipulated in some legal acts, including: the national Development Strategy Moldova 2020, the Energy Strategy of the Republic of Moldova until 2030,

Table ES-2: Direct Greenhouse Gas Emissions in the Republic of Moldova by Sector within 1990-2015, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Energy	34.6308	30.7803	21.3699	16.1330	15.1511	11.8855	12.1887	10.9476	9.4270
2. Industrial Processes and Product Use	1.5810	1.4026	0.8144	0.7331	0.5529	0.4535	0.4129	0.4550	0.3809
3. Agriculture	5.2106	4.8569	4.3977	4.2227	3.7517	3.5906	3.4009	3.1810	2.9467
4. LULUCF	-5.8197	-7.5773	-7.0514	-7.1366	-6.3455	-6.4821	-6.2262	-6.0886	-6.1414
5. Waste	1.9777	1.9479	1.8030	1.8497	1.7471	1.7202	1.7098	1.7191	1.6514
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	7.4725	6.7878	7.3880	7.1323	7.8500	8.3637	8.6817	7.8533	8.0245
2. Industrial Processes and Product Use	0.3452	0.3190	0.3243	0.3770	0.4119	0.4897	0.5986	0.7092	0.9713
3. Agriculture	2.6892	2.5002	2.6728	2.7425	2.4246	2.5921	2.5765	2.4631	1.6847
4. LULUCF	-6.1121	-6.0570	-5.7928	-4.8670	-4.9273	-3.8846	-4.7644	-5.0355	-5.0242
5. Waste	1.6159	1.6007	1.5911	1.5503	1.5356	1.5262	1.5573	1.5369	1.5282
	2008	2009	2010	2011	2012	2013	2014	2015	%
1. Energy	8.6140	9.3023	9.8287	9.9961	9.6545	8.5633	9.3447	9.5049	-72.6
2. Industrial Processes and Product Use	1.0639	0.5601	0.6050	0.6985	0.7164	0.7703	0.8049	0.7951	-49.7
3. Agriculture	2.2384	2.0703	2.2497	2.2040	1.7758	2.2490	2.4879	2.1147	-59.4
4. LULUCF	-4.4876	-3.8521	-3.2301	-2.6440	-2.9451	-2.5470	-2.6610	-2.8454	-51.1
5. Waste	1.5522	1.5417	1.5801	1.6044	1.6018	1.5661	1.5619	1.5387	-22.2

Table ES-3: Ozone and Aerosol Precursors (NO_x, CO and NMVOC) and SO_2 Emission Trends in the RM within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	137.1930	124.3404	78.2802	62.5812	58.3531	49.3980	47.1068	43.6544	36.5540
CO	439.0588	371.4113	173.3580	146.0255	141.2352	139.9312	141.2185	149.7084	126.2339
NMVOC	183.0223	155.2900	105.8855	87.4951	67.2505	66.0356	62.3036	49.5601	43.5191
SO_2	294.2491	244.2434	169.7527	137.1709	100.3805	59.5089	58.3896	33.5716	26.3976
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	26.7366	25.2064	27.4804	28.7878	31.1685	33.2657	34.5095	32.6202	35.0212
CO	85.4601	84.3441	87.4949	107.8300	128.7661	131.1277	133.5524	128.7570	127.6376
NMVOC	31.4470	31.0555	33.2102	38.5332	43.1876	56.0942	59.3127	63.1443	64.1206
SO_2	13.4319	9.5508	9.1867	10.3037	12.3242	11.1911	10.9459	11.2334	9.2497
	2008	2009	2010	2011	2012	2013	2014	2015	%
NO_x	37.5402	37.5455	40.5531	41.2474	38.4362	37.4587	41.2859	43.2178	-68.5
CO	133.1239	130.8874	130.1470	136.8043	122.5016	121.5024	160.1651	169.0056	-61.5
NMVOC	58.5079	52.8153	57.0391	60.7789	59.7134	58.9806	72.1587	70.3063	-61.6
SO_2	15.7014	19.4449	19.0192	17.8646	16.9376	19.8122	22.5976	21.8899	-92.6

the Law on Energy Efficiency, the Law on Renewable Energy, the Law on Thermal Energy and Cogeneration Promotion, the National Agribusiness Sustainable Development Strategy of the Republic of Moldova (2008-2015), the National Waste Management Strategy 2013-2027, and other.

The policies set forth in the above documents are to be implemented through programs and plans attached thereto. In this sense, the National Energy Efficiency Programme for 2011-2020, the National Action Plan on Renewable Energy for 2013-2020, the Methodology for setting, approval and application of tariffs on electricity produced from renewable energy sources and biofuels, the Soil Fertility Conservation and Enhancement Program for 2011-2020, the State Programme of Regeneration and Afforestation of forest lands for 2003-2020, and other have been approved and are being implemented. In order to implement the mapped-out policies the country has the necessary institutional structures.

ES.4.1. Economic Instruments

Taxes and incentives are acknowledged as the most influential instruments to achieve the GHG emissions reduction objective. It should be admitted, however, that until now, few levers of this kind have been used in the Republic of Moldova, and the ones aimed at GHG emissions mitigation did not work. Nevertheless, it should be mentioned that the Government has increasingly used incentives for promoting energy efficiency and renewable energy sources, by providing grants worth up to 80% of the project investment value.

ES.4.2. Climate Change Mitigation Policies and Measures at Sector Level

ES.4.2.1. Energy Sector

The energy sector policies are reflected mainly in the Energy Strategy of the Republic of Moldova until 2030, which has three main objectives: security of energy supply, in conditions when the country imports about 86.2% of the needed energy resources; developing competitive markets and their regional and European integration; environmental sustainability and climate change control.

Chapter "Environmental sustainability and combating climate change" provides for increasing energy efficiency and more extensive use of renewable energy sources by creating a up to date regulatory framework.

Objectives mapped out for the timeline until 2020 are:

- reducing energy intensity by 20% until 2020;
- reduction of losses in transmission and distribution networks: by up to 11% until 2020 for electricity; by 39 % until 2020 for natural gas; and respectively by 5% until 2020 for heat;
- reducing GHG emissions by 25% until 2020;
- reducing energy consumption in buildings by 20% by the year 2020;
- achieve the level of 10% in refurbished public buildings until 2020;
- ensure the 10% annual share of electricity produced from renewable energy sources until 2020;
- ensuring the 10% share of biofuels in the total fuel production by 2020.

The LEDS also provides for unconditional reduction of GHG emissions in the energy sector by 74% until 2030 compared to 1990, and conditional reduction by 82% for the same period.

Electricity from Renewable Sources

The policy framework governing the promotion of production of electricity from renewable sources is established in the Law on the Use of Energy from Renewable Sources. The paper provides for the tendering method aimed at selecting eligible producers who will have the right to sell electricity generated from renewable sources. Implementation of the grid connected RES, however, collides with the lack of balancing power.

Biomass-Based Heating

The policy framework governing the promotion of biomass use is established in the Law on Energy Efficiency, formulated more pragmatically in the National Energy Efficiency Programme for 2011-2020 and National Action Plan on Renewable Energy Sources for the years 2013-2020. The policies concerned are also implemented by the Energy Efficiency Fund created in 2012, as well as through the international donors support.

Cogeneration Power Plants

The basic legislation setting out the policies on the use of cogeneration power plants is the Law on Thermal Energy and Promotion of Cogeneration. Because of lack of thermal load, development of such plants in the country is viewed with reservations. At the same time, according to estimates, the potential for construction of the new feasible CHPs is circa 20-30 MW.

ES.4.2.2. Transport Sector

Reduction of GHG emissions in the transport sector are expected to result from:

a) Reduction of the carbon content in fuel used for land vehicles, by substituting the traditional fuels (gasoline and diesel) with compressed natural gas and liquefied petroleum gas, and by dilution of traditional fuels with bio-fuels;

b) Increase in fuel combustion efficiency by lowering the age of imported automotive vehicles (the country doesn't produce automobiles);

c) Encouraging the use of environmentally friendly means of transport and promoting public transport as well as zero emissions transport modes (cycling, walking). So far such encouragements were least promoted;

d) Promoting global emissions trading schemes. The aviation sector is the first sector in the RM to be included in the European Union emissions trading scheme, with an officially established ceiling of emissions;

e) Improving the infrastructure and charging for its use. It is estimated that fuel consumption increases by up to 20% on roads in poor condition.

Aiming at achieving the NDC goal, the LEDS provides for the Transport Sector to contribute to the unconditional GHG emissions reduction by 30% in 2030 compared to the level of 1990.

ES.4.2.3. Buildings Sector

GHG emissions attributed to buildings make up 21% of the total direct GHG emissions. Policies aimed at reducing energy consumption in buildings are outlined in the National Energy Efficiency Program 2011-2020, the Energy Strategy of the Republic of Moldova until 2030, as well as in the draft Law on the Energy Performance of Buildings. Aiming at achieving the NDC goal, the LEDS provides for the Buildings Sector to unconditionally reduce GHG emissions by 77% in 2030 compared to the level of 1990.

ES.4.2.4. Industrial Sector

The environmental aspects related to industrial sector are reflected sporadically in some legislative acts and, as a rule, are tackled very generally. At the same time, the RM signed the international agreement on ozone layer depleting substances, and also passed a relevant law. GHG emissions reduction through energy efficiency is provided for in several documents, where the international donors contribution plays an important role. Aiming at achieving the NDC goal, the LEDS provides for the Industrial Sector to contribute to the unconditional GHG emissions reduction by 45% in 2030 compared to the level of 1990.

ES.4.2.5. Agricultural Sector

GHG in the agricultural sector have three main sources: enteric fermentation, manure management, and agricultural soils. Aiming at achieving the goal to increase the livestock productivity, the country is implementing programs and strategies designed to improve the genetic pool of domestic animals and poultry, tending to reduce specific GHG emissions. The use of manure is increasingly growing every year, either for biogas production reasons, or for the purpose of enhancing soil fertility, which will also result in GHG emissions reduction. GHG emissions reduction is also expected to occur as a result of promoting soil conservation farming methods. Aiming at achieving the NDC goal, the LEDS provides for the Agricultural Sector to contribute to the unconditional GHG emissions reduction by 37% in 2030 compared to the level of 1990.

ES.4.2.6. Forestry Sector

At present, forests cover approximately 12% of the territory of the country, which is insufficient to have a balanced ecosystem. Aiming at improving the situation, the authorities set the goal to increase forested areas up to 15% by the year 2020, improving at the same time the condition of the existing forests. To this end, a number of policies aimed at achieving this goal have been approved over the last decade, while the main steps are outlined in the State Program for regeneration and afforestation of forest lands, planned for the period 2003-2020. The CDM Projects "Conservation of Soils in Moldova" and "Development of the forestry community sector in Moldova" also contribute to achieving this goal. Aiming at achieving the NDC goal, the LEDS provides for the LULUCF Sector to contribute to unconditional sequestration by 2030 of 62% of the value of GHG sequestrated in 1990.

ES.4.2.7. Waste Sector

GHG emissions mitigation policies in the waste sector are geared toward discouraging of storing waste on solid waste disposal sites and encouraging recycling, providing sewerage services to the entire urban area, and social facilities in rural areas. Aiming at implementing the above, the following legislation has been passed: Law on Waste, Waste Management Strategy of the Republic of Moldova for the years 2013-2027, the Law on Environmental Pollution Payments, the Law on Production Waste and Household Waste, the Law on Protection of the Atmospheric Air, etc. However, the measures taken so far were not successful enough. The intention to apply fees and taxes encountered implementation difficulties because of inconsistencies in the chain starting from pricing up to actual payment of fees and taxes. Nevertheless, even without tangible legal incentives to use biodegradable waste, businesses apply the waste management policy by reusing waste, the main incentive being the high price of fossil fuels. To reduce GHG emissions from the waste sector also contributes. The two CDM projects in progress "Production of biogas from sugar beet pulp pressed at Südzucker Moldova sugar refinery" (Drochia district, Moldova) and "Capturing landfill gas and electricity production at the solid waste disposal site" (Tîntareni, Republic of Moldova). Aiming at achieving the NDC goal, the LEDS provides for the Waste Sector to achieve an unconditional GHG emissions reduction by 38% in 2030 compared to the level of 1990.

ES.5. GHG Emissions Projections and Overall Impact of Climate Change Mitigation Policies and Measures

ES.5.1. Long-Term Projections on Evolution of Direct GHG Emissions in the Republic of Moldova

As a result of the promotion of GHG emissions mitigation policies and measures reflected above (Chapter ES.4), it is expected that the evolution of GHG emissions and sequestrations in Moldova will looks as follows (Table ES.5-1). As shown in the table, it is expected that GHG emissions will decrease by 57% in 2030, compared to 1990, which is by 7-10% less than the values provided in the NDC of the country. The difference is caused by the use of the IPCC 2006 Guidelines instead of IPCC 2000 and IPCC 1997 Guidelines used to determine the country's NDC objectives. Also, the calculation of GHG emissions projected for the year 2030 was influenced by the employed new population evolution scenario developed on the basis of 2014 population and housing census findings, as well as the GDP evolution by the year 2030, which has been revised.

In addition to direct GHG emissions projections set out in Table ES.5-1, which are in line with WM scenario, that is, the country's GHG emissions mitigation policies described in detail in Chapter 3 of the Fourth National Communication of the Republic of Moldova to the UNFCCC, the report also contains the GHG emissions projections for the BAU and for the WAM scenarios.

Table ES.5-1: GHG emissions in the Republic of Moldova, WM, kt CO_2 equivalent

GHGs	1990	1995	2000	2005	2010	2015	2020	2025	2030
CO_2 (net emissions)	29 013	5 037	320	3 621	6 360	6 492	7 390	8 969	10 512
CH_4	5 706	4 169	3 322	3 303	2 914	2 863	3 180	2 872	2 946
N_2O	2 861	1 956	1 499	1 760	1 644	1 573	1 870	1 972	2 110
F-gases	-	5	10	42	113	179	302	399	516
Total Net GHG Emissions	37 580	11 167	5 151	8 726	11 031	11 108	12 741	14 212	16 086
Changes compared to the year 1990, %		-70	-86	-77	-71	-70	-66	-62	-57

ES.5.2. Tools Used in Assessment of the Direct GHG Emissions Mitigation Potential

The direct GHG emissions mitigation potential has been assessed using the following tools:

- Energy Sector: WASP and IMPACT models from the ENPEP; MS Excel based calculation tools developed by experts;
- Industrial Processes and Product Use Sector, Agriculture and LULUCF Sectors: Excel spreadsheets developed by experts using the IPCC 2006 Guidelines calculation methodology;
- Waste Sector: First Order Decay Methodology and the Excel spreadsheets developed by experts using the IPCC 2006 Guidelines calculation methodology was used to assess the mitigation potential of methane and nitrous oxide emissions from waste sector.

ES.5.3. Medium-Term Projections of Direct GHG Emissions Evolution by Sector

ES.5.3.1. Energy Sector

I. Electricity Generation and Combined Heat and Power Generation Sectors

BAU scenario provides for keeping the existing power plants in operation until year 2019. Starting with the year 2020 the existing local CHPs will be rehabilitated to only allow operation until year 2035. The level of energy imports after year 2016 has been set at the level of 25% for the entire country. The CTEM, with its recent six groups, has been shaped to meet the demand of both banks of the Dniester river. Its available power will not exceed 1320 MW. All groups work on natural gas. The WM scenario is in line with the Energy Strategy 2030 geared towards self-balancing demand and supply of electricity load after year 2020. In this regard, until year 2019 the power plants in the WM scenario will repeat the BAU scenario. By the year 2020 the CHP-2 will be rehabilitated, and will maintain its capacity to 240 MW. In addition to CHP-2 other power plants will be put into operation, including RES plants, the capacity and year of commissioning depending on the WASP optimal option. The CTEM covers the need for energy in Transnistria only, and as appropriate, will cover a part of the electricity consumption on the right bank of the Dniester river. Until 2019 the level of energy imports has been established to remain the same as in 2016. Starting with the year 2020, asynchronous interconnection with Romania, a total of 6 x 250 MW, will be gradually put into operation. The WAM scenario is virtually the same as the WM scenario described above, except that it differs by covering a smaller energy and load demand over the years; the construction of renewable electricity plants and much greater capacity than in WM scenario, circa 1026 MW by year 2030, instead of 426 MW in WM scenario; the construction of a small capacity "back-to-back" station, up to 6 units of 174 MW each. In the year 2030, the total amount of emissions under the BAU scenario will be 22% of total direct GHG emissions of this current year, respectively 23.6% under the WM scenario, and 17.9% under the WAM scenario.

II. Thermal Power Sector

The calculation of GHG emissions has been done separately for each source of emissions in the sector: 1A1aiii "Heat Production"; 1A2 "Manufacturing Industry and Construction"; 1A4a "Commercial and Institutional Sectors" and 1A4b "Residential Sector"; 1A4c "Agriculture, Forestry and Fisheries Sectors", using the results of heat consumption calculation by types of primary sources. After year 2015 over 99% of emissions in the Thermal Power Sector are emissions CO_2. By 2030, under the BAU the amount of emissions will reach 5219.9 ktCO_2 equivalent, of which 15.7% will be produced by the emissions source 1A1a; 33.8% - by the source 1A2; and 41% - by the sources 1A4a and 1A4b; 9.5% - by the source 1A4c. Under the WM scenario: respectively, 17.5%; 38%; 34.5%; 10.1%, and under the WAM scenario: 16.1%; 40.6%; 31.9% and 11.4%.

III. Transport Sector

Related to the BAU scenario, the WM scenario promises a circa 13% decrease of the GHG emissions from the Transport Sector by year 2030, while the WAM scenario provides for a circa 25% decrease. Most emissions in the Transport sector are of CO_2 type. For the period 2020-2030 their share under all scenarios considered amounts to 97% of all GHG emissions in this sector.

ES.5.3.2. Industrial Processes and Product Use Sector

Compared to the baseline year 1990 levels, the level of direct GHG emissions from the Industrial Processes and Product Use sector by the year 2030 will be by 5.9% higher under the BAU scenario, by 7.7% lower under the WM scenario, and by 18.8% lower under the WAM scenario. The main source of emissions is the 2A "Mineral Industry", with over 50% of emissions of this sector, followed by 2F "Product uses as ODS substitutes", with over 31% of the total.

ES.5.3.3. Agriculture Sector

The total amount of GHG emissions from the Agriculture sector is almost equally shared by the plant cultivation and animal husbandry sectors. So, in animal husbandry sectors, under the BAU scenario, by year 2030, the emissions will account for 1434.5 kt CO_2 equivalent (51%), while in plant cultivation - 1379 kt CO_2 equivalent (49%); under the WM scenario these amounts will account for, respectively 49% and 51%; and under the WAM scenario - 47% and 53%. After year 2015 GHG emissions grow under all three scenarios, BAU, WM, and WAM, as a result of development needs of the agricultural sector which has been in regression since 1990. By the year 2030, under all three scenarios, the GHG emissions will account for about 54% of the respective emission levels recorded in 1990.

ES.5.3.4. LULUCF Sector

Under all three scenarios, BAU, WM, and WAM, the 4A "Forest land" and 4B "Cropland" have the highest contribution to the total amount of CO_2 emissions sources and sinks. While under the WM and WAM scenarios for the timeline 2020-2030 sinks are growing in 4A "Forest land", the 4B "Cropland" show an increase in the CO_2 emissions caused, on the one hand, by shrinking of cultivated lands areas, and on the other hand – by too slow CO_2 emissions due to dramatic decrease of organic matter flow in cultivated arable lands. So, the drastic decrease carbon return in soil at the expense of manure has led to a shift from a positive balance of soil carbon of 0.56 t/ha in the year 1990, to a deeply negative minus 0.60 t/ha in the year 2010. During the period 2000-2010 the soil carbon balance in agricultural soils became negative - on average 0.50 t/ha/year. As a consequence, the GHG emissions from 4B source increased from circa 1747.3 kt CO_2 in 1990 to circa 1937.2 kt CO_2 in 2015. As a result, all scenarios feature a substantial decrease in CO_2 removals in the Republic of Moldova. Compared to year 1990, the amount of CO_2 removals is expected to reach 0.6% only under the BAU scenario, 7.3% under the WM scenario, and 6% under the WAM scenario.

ES.5.3.5. Waste Sector

During the years 2015-2030 the main source of GHG emissions in the Waste sector is 5A "Solid Waste Disposal", with 70-72% of the total by the sector, depending on the scenario, followed by 5D "Waste Water Treatment and Discharge", with 20-28% calculated for the same scenarios and conditions. By the year 2030 the level of direct GHG emissions under the BAU scenario will exceed the emissions level of year 2010 by 20.6%, while the WM and WAM scenarios show a decrease of emissions, respectively by 4.1% and 7.8%. Compared to year 1990, emissions decrease in the last two scenarios is even more pronounced, by 23.3% under the WM scenario and by 26.3% under the WAM scenario. The BAU scenario also shows a decrease of GHG emissions by 2030, by 3.7%, compared to year 1990.

ES.5.4. Medium and Long-Term Projections Regarding the Evolution of Aggregate National Direct GHG Emissions

In comparison with the national direct GHG emissions (without the contribution of the LULUCF sector) of the year 1990, it is expected that by the year 2030 the total direct GHG emissions will decrease by approximately 56% under the BAU scenario, by 62% under the WM scenario and by about 68% under the WAM scenario. In terms of net GHG emissions by the year 2030 compared to the year 1990, will feature respectively, 49% under BAU, 57% under WAM, and 63% under WAM. Figure ES.5-1 and Table ES.5-2 reveal the evolution of aggregate national direct GHG emissions in the period 1990-2030.

Table ES.5-2: Aggregate projections of national and by sector direct GHG emissions in the RM under scenarios considered for the period until year 2030, kt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
Energy	34 631	11 885	6788	8682	9829	9505	8834	10 447	12 497
Industrial processes and product use	1581	454	319	599	604	795	1 150	1 447	1 834
Agriculture	5211	3591	2500	2577	2250	2 115	2 500	2 641	2 819
LULUCF	-5820	-6482	-6057	-4764	-3232	-2845	-690	-396	34
Waste	1978	1720	1601	1557	1580	1539	1873	1844	1905
Total national GHG, with LULUCF	37 580	11 167	5151	8650	11 031	11 108	13 668	15 983	19 089
Total national GHG, without LULUCF	43 400	17 649	11 208	13 414	14 263	13 953	14 358	16 379	19 055
WM									
Energy	34 631	11 885	6788	8682	9829	9505	8227	9640	10 701
Industrial processes and product use	1581	454	319	599	604	795	1038	1239	1461
Agriculture	5211	3591	2500	2577	2250	2 115	2 546	2 674	2 835
LULUCF	-5820	-6482	-6057	-4764	-3232	-2845	-884	-813	-427
Waste	1978	1720	1601	1557	1580	1539	1813	1472	1516
Total national GHG, with LULUCF	37 580	11 167	5151	8650	11 031	11 108	12 741	14 212	16 086
Total national GHG, without LULUCF	43 400	17 649	11 208	13 414	14 263	13 953	13 625	15 025	16 512
WAM									
Energy	34 631	11 885	6788	8682	9829	9505	6955	7865	8502
Industrial processes and product use	1581	454	319	599	604	795	971	1121	1285
Agriculture	5211	3591	2500	2577	2250	2 115	2 599	2 712	2 841
LULUCF	-5820	-6482	-6057	-4764	-3232	-2845	-805	-782	-351
Waste	1978	1720	1601	1557	1580	1539	1805	1450	1458
Total national GHG, with LULUCF	37 580	11 167	5151	8650	11 031	11 108	11 525	12 365	13 735
Total national GHG, without LULUCF	43 400	17 649	11 208	13 414	14 263	13 953	12 329	13 148	14 086

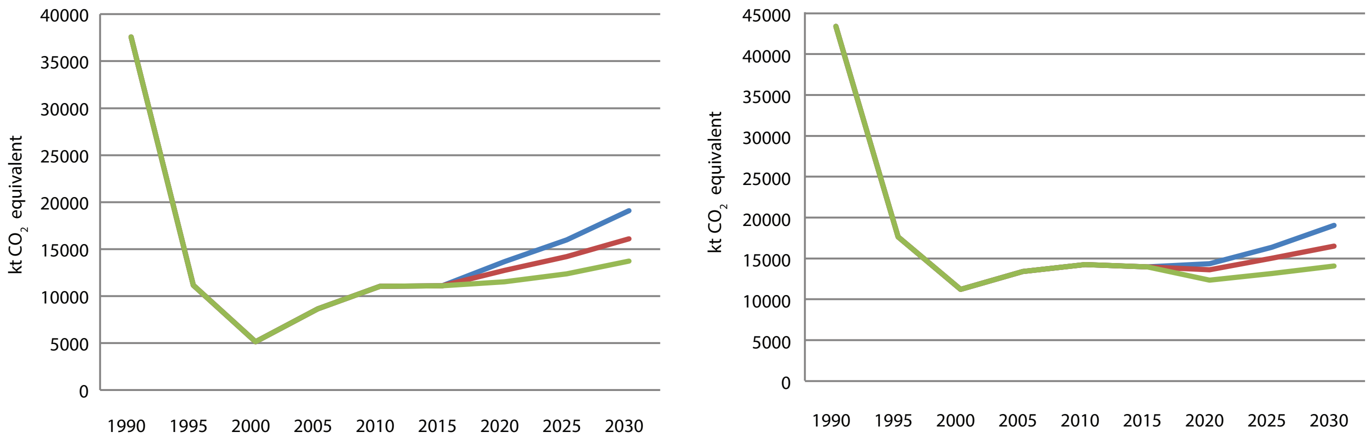


Figure ES.5-1: Aggregate projections of national direct GHG emissions under scenarios considered for the period until year 2030, (a) with contribution of LULUCF sector; (b) without contribution of LULUCF sector

ES.6. Vulnerability Assessment and Climate Change Impacts

ES.6.1. Current Climate of the Republic of Moldova

I. Summary of Observed Trends in Temperature and Precipitation

Over the last 127 years (1887-2014), the RM has experienced the changes in temperature and mean precipitation. The country has become warmer, with the average temperature increase greater than 1.0°C, while the increase in precipitations constituted only around 54.7 mm. The early 1980s are generally regarded as a kind of "breaking point" in the long-term air temperature curve, from which the human influence on the atmosphere is expressed most distinctly (IPCC, 2007); this fact was confirmed statistically both by foreign (Gil-Alana, 2008) and national studies (Corobov et al, 2013; Țăranu, 2014). The temperature rise is clearly seen (from an average annual value of 8.5°C in the North to 10.3°C in the South), followed by a decrease in the amount of annual precipitation, respectively, from 622 mm to 508 mm. The air temperature rises on the territory of the RM over the years 1981-2010 bears no doubt and it is most clearly seen during the warm season, especially in summer, when the T_{mean} rises by 0.9-1.0°C, and T_{max} - by 0.9-1.3°C per decade with a very high degree of certainty. Climate is getting warmer to a lesser degree during the winter months, by 0.4-0.6°C per decade and this growth is statistically significant ($p \geq 0.10$) only for Cahul.

For southern regions, the greatest temperature rise is registered due to T_{max}, while for northern and central regions - due to T_{min}. In the transitional seasons, the greatest statistically significant increase in temperature is observed for T_{max} in the spring of 0.7°C (Briceni) to 1.0°C (Cahul) over the decade, and the lowest over autumn of 0.3°C (Briceni) to 0.6°C (Cahul) per decade. However, T_{min} shows the reverse pattern with autumn growth of 0.6°C (Cahul) to 0.7°C (Briceni) as compared to 0.5°C (Briceni) and 0.6°C (Cahul) per decade in spring. In annual terms, also the largest increase T_{max} 0.9°C per decade is observed in Cahul against 0.5°C in Briceni, while the largest increase in T_{min} is observed, on the contrary, in Briceni 0.7°C per decade as opposed to 0.6°C in Cahul. Unlike temperature, statistically significant changes in precipitation are not observed, except for a statistically significant increase in summer precipitation of 30 mm per decade for Briceni. The upward trend in mean annual rainfall is observed in the North (44.7 mm) and the Centre (13.2 mm) per decade, while for the South the trend is towards a reduced growth of autumn precipitation of 9.2 mm per decade. Moreover, a trend towards decrease of precipitation is observed in the South during all seasons, except autumn, while in the centre decrease is seen only in summer.

II. Summary of Observed Trends in Temperature and Precipitation Extremes Indices

Extreme climate events and their changes are of particular relevance to society and ecosystems due to their potentially severe impacts as emphasized in the Special Report on Extreme Events (SREX) of the Intergovernmental Panel on Climate Change (IPCC, 2012).

The annual maximum daily minimum (TNx) and maximum daily maximum (TXx) temperatures have increased during the 1961-2014 over the RM. The *CLTS* values of the TNx and TXx on the entire territory of the RM were statistically significant, had a positive sign and varied from +0.4 to +0.6°C/10 years, R^2 was from 15% to 33%, which shows gradual increase in the TNx and TXx during the 1961-2014 years in the region. The value of the determination coefficient, R^2, amounting to 20-33% is higher for the annual maximum daily minimum (TNx) temperature, with *CLTS* from +0.4 to 0.6°C/10 years, which shows a greater statistical significance of changes in TNx on the territory of the RM towards warming, especially in Central and Southern AEZs during the 1961-2014 years.

Unlike the TNx and TXx, statistically significant changes in annual minimum daily minimum (TNn) and maximum daily minimum (TXn) temperatures are not observed. The upward trend in TNn is observed in Northern and Central by +0.5°C per decade, while for Southern AEZs the trend is higher by +0.6°C per decade, and vice versa the decreasing trend in TXn is observed in Northern (-0.1°C per decade), Central (-0.2°C per decade), and for Southern AEZs the trend is by -0.01°C per decade. The negative trend statistically significant of diurnal temperature range observed in Northern (-0.09°C per decade) and Central AEZs (-0.14°C per decade) indicates that daily minimum temperature increases with higher magnitude than daily maximum temperature.

During the 1961-2014, have observed decreases in FD and ID over the RM. The *CLTS* values of the FD on the entire territory of the RM were statistically significant, had a negative sign and varied from -3.2 (Central AEZ) to -4.7 (Northern AEZ) days/10 years, R^2 was from 12% to 24%, which shows a gradual decrease in the FD in the region. The value of the determination coefficient, R^2, amounting to 2-9% is considerably lower for the ID, with *CLTS* by -3.1 days/10 years, which shows a statistical significance of changes only in Northern AEZ. The decreasing trend in ID is observed in Central (-1.1 days per decade), and Southern AEZs (-0.7 days per decade).

The increasing trend in TR and SU have observed during the 1961-2014 over the RM. The *CLTS* values of the TR on the entire territory of the RM were statistically significant, had a positive sign and varied from +3.5 (Northern AEZ) to +2.3 (Southern AEZ), with maximum +3.6 (Central AEZ) days/10 years, R^2 was from 17 to 41%, which shows a gradual increase in the TR in the region. The value of the determination coefficient, R^2, amounting to 7-15% is considerably lower for the SU, with *CLTS* from +4.0 to +4.3 days/10 years, statistical significance in Northern and AEZ. The decreasing trend in ID is observed in Central and Southern AEZs (-1.1 days/10 years), respectively.

In consistence with warming and observed trends of absolute and threshold temperature indices a decrease in TN10p and TX10p was observed during the 1961-2014 over the RM. The *CLTS* values of the TN10p on the entire territory of the RM were statistically significant, had a negative sign and varied from -1.7 (Northern AEZ) to -1.0 (Southern AEZ) %/10 years, R^2 was from 17% to 43%, which shows a gradual decrease in the cold nights in the region. The value of the determination coefficient, R^2, amounting to 3-9% is considerably lower for cold days (TX10p), with *CLTS* by -0.8 %/10 years, which shows a statistical significance of changes only in Northern AEZ. The decreasing trend, statistical not significant in TX10p is observed in Central (-0.5 %/10 years), and in Southern AEZs (-0.6 %/10 years).

The warm nights (TN90p) and warm days (TX90p) have increased during the 1961-2014 over the RM. The *CLTS* values of the TN90p and TX90p on the entire territory of the RM were statistically significant, had a positive sign and varied from +2.4 (Northern AEZ) to +2.0 (Southern AEZ), with maximum +2.6 (Central AEZs) %/10 years and from +1.0 (Central AEZ) to +1.6 (Northern and Southern AEZs) %/10 years. The R^2 was from 35 to 49% and from 9 to 22%, respectively, which shows consistent increase in the TNx and TXx during the 1961-2014 years in the region. The value of the determination coefficient, R^2, amounting to 35-49% is higher for the warm nights (TN90p), with *CLTS* from +2.0 to 2.6 %/10 years, which shows a greater statistical significance of changes in TN90p on the territory of the RM towards warming, especially in Northern and Central AEZs during the 1961-2014 years.

Trends in temperature-based percentile indices cold nights (TN10p), cold days (TX10p), warm nights (TN90p), and warm days (TX90p) were compared to examine the consistence in the magnitude of change across the Republic of Moldova in 1961-2014 years. The linear regression slope, fitted to the combined change rates of annual cold nights against warm nights are -0.96% per year, while cold days versus warm days are -0.67% per year. According to these ratios, it is clear that the increased frequency of annual warm nights is greater than the decrease in cold nights across the Republic of Moldova, and frequency of annual warm days increases fasters than the rate of the annual cold days' decreases. Furthermore, the slope of linear regression from the annual cold days versus cold nights are +0.69% per year, while warm days against warm nights are +0.91% per year.

The patterns of recent changes in precipitation indices appear spatially more heterogeneous across the Republic of Moldova than the consistent warming pattern seen in the temperature indices. Observational records of most of the precipitation extreme indices do not indicate significant trends in case of parametric as well as non-parametric (distribution-free) estimations across the Republic of Moldova. Some changes in these variables have been observed across the Republic of Moldova's AEZs but most of them are not statistically significant due to large natural variability. Most of the precipitation indices show changes toward more intense precipitation over northern and central AEZs. Such changes in extreme precipitation are found, for example, for the average intensity of daily precipitation (SDII), number of heavy (R10mm) and very heavy precipitation days (R20mm).

All indices display upward trends during the past 50 years. Similar patterns of change are also found for the annual total precipitation in wet days (PRCPTOT) and contribution from very wet days (R95pTOT) and extremely wet days (R99pTOT). All precipitation-based indices show larger areas with not significant trends toward wetter conditions than areas with drying trends. In southern AEZ have been observed not significant trends toward less frequent and intense precipitation, except for contribution from extremely wet days (R99pTOT). Observational records do not indicate significant trends in either the number of dry days (indicating drought risks) or consecutive wet days (indicating flood risks) in case of parametric as well as non-parametric (distribution-free) estimations across Republic of Moldova. Some changes in these variables have been observed across Republic of Moldova's AEZs but all of them are not statistically significant due to large natural variability. According to parametric as well as non-parametric (distribution-free) estimations, central AEZ reveals decreasing trends, not statistically significant, in both the number of wet days and dry days, also, in southern AEZ have been observed not statistically significant trends toward increasing trends in the number of dry days (indicating drought risks) and decreasing in the number of wet days (indicating flood risks). According to non-parametric (distribution-free) estimations in northern AEZ have been observed not statistically significant trends toward increasing in the number of wet days (indicating flood risks), and decreasing in the number of dry days.

ES.6.2. Climate Change Scenarios for the Republic of Moldova's Climate Vulnerability Assessment

The model simulations for precipitation and temperature used in this report stem from 21 of the global coupled atmosphere ocean general circulation models (AOGCMs) made kindly available by the WCRP Coupled Model Intercomparison Project – Phase 5 (CMIP5) [the CMIP5 multi-model ensemble [archive/output/results/of simulations/dataset/] CLIVAR Exchanges Newsletter, 2011; Taylor et al., 2012; Hibbard et al., 2007; Meehl et al., 2007.

Totally 84 simulations for 21 global coupled atmosphere ocean general circulation models (AOGCMs) were downloaded and assessed. The GCM simulations were grouped into three multi-model ensembles (averages) depending on the different RCP8.5, RCP4.5 and RCP2.6 emission scenarios and the climatic changes over the domain of study were computed for three different future periods (2016-2035, 2046-2065 and 2081-2100) with respect to the control (reference) period (1986-2005). The first feature to highlight is that, both for temperature and precipitation, the multi-model ensemble average changes consistently have the same sign across scenarios and their magnitude increase from the low GHG emissions scenario (RCP2.6) to the high GHG emissions scenarios (RCP4.5 and RCP8.5), as we move into the later decades of the 21st century.

I. Projections of Future Changes in Annual and Seasonal Temperatures

Annual changes for temperatures are very homogeneous over the Republic of Moldova's AEZs. By 2100, the rate of warming is higher under RCP 8.5; ensemble average would be +4.6ºC; medium +2.4ºC under RCP 4.5; and smaller +1.3ºC under the RCP2.6. Although, individual GCMs show an increase of up to 6.3-6.7ºC. The warming would be higher during winter, up to +4.6ºC in the Northern AEZ, while in Central and Southern AEZ's the temperature rise will be lower, up to +4.2ºC according to the RCP 8.5 scenario. The RCP2.6 scenario reveals less intense warming, from +1.2 to +1.4ºC. The summer warming is found to be even larger than winter, but the spatial distribution of the changes is quite different. The strongest temperature rise would occur over the Southern and Central AEZs. The ensemble driven by RCP 8.5 scenario estimate that the RM's AEZs will experience by 2100 the most significant warming during summer, from +5.9ºC in the Northern AEZ, to +6.1ºC in the Southern AEZ. The pattern of change derived from the ensemble RCP 2.6 models is quite similar, but the magnitude of change is lower, from +1.3 to +1.5ºC.

II. Projections of Future Changes in Annual and Seasonal Precipitation

Annual changes for precipitation became much more differentiated over the RM's AEZs by the 2100. The multi-model projections from the RCP 8.5 forcing scenario show that the RM's AEZs would exhibit a general annual decrease in precipitation varying from 9.9% in Northern to 13.4% to Southern AEZs. Conversely, according to RCP 2.6 scenario moderate increase in precipitation from 3.1% in Northern to 5.1% to Southern AEZs by 2100 is projected. The corresponding results from the RCP 4.5 scenario show a moderate increase in precipitation from 1.6% to 3.6% only in Central and Northern AEZs by 2100 relative to the base period 1986-2005.

The multi-model projections from the RCP 8.5, RCP 4.5 and RCP 2.6 forcing scenarios show that the RM would exhibit a general increase in precipitation during winter and spring. Winters are estimated to be wetter in the RM by the end of the 21st century. The ensemble projections reveal the largest increase in precipitation by 2100, from 4.0% (RCP 2.6) to 11.8% (RCP 8.5) in winter over the Northern AEZ; and the lowest one, from 3.0% (RCP 2.6) to 7.4% (RCP 8.5), in the Central parts of the country. The ensemble averages for the three RCP scenarios agree that the precipitation reduction will be much more extended in the RM during summer and autumn. The ensemble projections forced by RCP 8.5 scenario project the greatest summer rainfall reduction, by 25.1% in the Central AEZ and the lowest, one by 18.1% in the Northern AEZ. The pattern of ensemble projection forced by RCP 2.6 is different, from a slight decrease of precipitation, by 0.7% over the Central AEZ, to an increase by +8.0% over the Southern AEZs, by 2100 relative to the base period.

III. Projections of Future Changes in Temperature and Precipitation Extreme Events

Climate temperature and precipitation extremes indices (TN10p, TX10p, TN90p, TX90p, WSDI, CSDI, TX_X, TX_N, TN_X, TN_N, FD, ID, SU, TR, DTR, RX1DAY, RX5DAY, SDII, R1MM, R10MM, R20MM, CDD, CWD, R95P, R99P, PRCPTOT) as defined and described in detail in Klein Tank et al. (2009) and Zhang et al. (2011) were modelled for the CMIP5 14 GCMs (BCC-CSM1-1, CanESM2, CCSM4, CNRM-CM5, CSIRO-Mk3-6-0, GFDL-ESM2G, HadGEM2-ES, IPSL-CM5A-LR, IPSL-CM5A-MR, MIROC5, MPI-ESM-LR, MPI-ESM-MR, MRI-CGCM3, NorESM1-M) under three RCP 8.5, 4.5 and 2.6 emission scenarios, and for observed historical data. The calculations were performed with the R package climdex.pcic.

Results generally show decreases in cold extremes, increases in warm extremes, and intensification of precipitation extremes in the future. They are in agreement with previous study performed at national level (Țăranu, 2014). Compared with earlier study, this study is more comprehensive, providing more detailed information on future changes in climate extremes for RM and AEZs based on new scenarios, and the new generation models.

The annual TNn and TXx are projected to increase in all three AEZs, with stronger warming under RCP 8.5 emission scenario. The projections under RCP 8.5 are also associated with larger interquartile model spread, due to different climate sensitivity of the models. There are some spatial differences in the projected changes in annual TNn and TXx. for instance, under RCP 8.5 the largest changes in TNn by +12.8°C occur in Northern AEZ, while the most intense warming in TXx is projected in Southern AEZ, with magnitude around +9.1°C.

The FD and ID are both projected to decrease everywhere by the end of the twenty-first century under all three scenarios, with strong model agreement. The projections indicate that the Northern AEZs will experience greatest decrease of FD and ID, with FD decreasing by 83 and ID by 53 days, under RCP 8.5. The largest increase in TR and SU is projected under RCP 8.5 in Southern AEZ, with an increase of TR and SU by 93 and 83 days, this means that if the future emission follow the path of RCP 8.5 of the worst model, Southern AEZ could experience night time temperatures above 20°C and day time temperatures above 25°C during the entire summer season.

The projected changes in temperature duration indices are consistent with what would be expected from warming and changes in absolute and threshold indices. That is, the cold spell duration index (CSDI) is projected to decrease and warm spell duration index (WSDI) to increase. The projected trend of decrease in WSDI is much larger under RCP 8.5 by 1.5 days/year (129 days) than RCP 2.6 by 0.15 days/year (27 days). The projected trend of decrease in CSDI is more comparable under RCP 2.6 and RCP 8.5 with median projected decrease being about 3 days (Southern AEZ) and 5 days (Northern AEZ), respectively. The asymmetry in the projected change of CSDI is due to the fact that the projected CSDI under the three scenarios would be mostly zero by the end of the twenty-first century.

Changes in night time temperature indices TN10p and TN90p are projected to be stronger than those in daytime temperature indices TX10p and TX90p. The TN10p and TX10p decreases is expected about 4% (under RCP 2.6) and/or 7% (under RCP 8.5) by the end of this century. Projection from different models converge as the projection approaches the zero-exceedance rate (all models project fewer and fewer cold nights and days toward the end of the century.

For the TN90p and TX90p, the median projected increases are from about +14-16% for 1986-2005 and 12.5-13.7% to 35-40% and 36-39% under RCP 8.5 by the end of the twenty-first century. That is, hot temperatures that occurred once every day in the late twentieth century would become everyday weather by the end of the twenty-first century under RCP 8.5 emission scenario. According to the optimistic RCP 2.6 scenario, the median projected increases for TN90p and TX90p are by +10-12% for both of indices, this is lower than in the base period 1986-2006.

The SDII is projected to increase everywhere by the end of the twenty-first century under all three scenarios, with strong model agreement. The projections indicate that Central AEZ will experience the greatest increase of SDII, with SDII increasing from 4.1 (RCP 2.6) to 6.7 % (RCP 8.5). By the end of the twenty-first century under RCP 2.6, the projected ensemble median of SDII increase will be from 3.1% in Northern to 3.6% in Southern AEZs and/or from 4.1% in Southern to 6.2% in Northern AEZs under RCP 8.5, respectively.

The RX1day is projected to increase everywhere by the end of the twenty-first century under all three scenarios. The projections indicate that Central AEZ will experience the greatest increase of RX1day, with RX1day increasing from 4.0% (RCP 2.6) to 8.5% (RCP 8.5) relative to base period 1986-2005. By the end of the twenty-first century under RCP 2.6, the projected ensemble median of RX1day increase will be from 2.3% in Northern to 4.8 % in Southern AEZs and/or from 6.7% to 8.0%, respectively under RCP 8.5.

The projections indicate that Central AEZ will experience the greatest increase of the R10mm, with R10mm increasing from 3.0 (RCP 2.6) to 10.9% (RCP 4.5) relative to base period 1986-2005. By the end of the twenty-first century under RCP 2.6, the projected ensemble median of R10mm increase will be from 4.1% in Northern to 9.6% in Southern AEZs and/or by 9-10%, respectively under RCP 4.5. By the end of the twenty-first century under RCP 2.6, the projected ensemble median of R20mm increase will be from 3% in Northern to 6% in Southern AEZs and/or by 11-12.5%, respectively under RCP 8.5, and medium increase by 8-9% according to RCP 4.5 emission scenario.

The PRCPTOT is projected to decrease everywhere by the end of the twenty-first century under RCP 8.5 and to increase according to RCP 4.5 and RCP 2.6 emission scenarios. The largest decrease in PRCPTOT is projected in Southern AEZ, with the decrease of PRCPTOT by 9.6 %, relative to base period 1986-2005. The projected PRCPTOT changes have very large spread among models, max +19.2 % and min -32.4 %. By the end of the twenty-first century, the projected ensemble median of PRCPTOT increase under RCP 2.6 will be from 2.6% in Northern to 6.6% in Southern AEZs and/or from 3.6% to 5.2%, respectively under RCP 4.5.

The projections indicate that Northern AEZ will experience the greatest increase of 95pTOT, with 95pTOT by 20% under RCP 8.5, whereas Southern AEZ will experience the greatest increase of 95pTOT by 19% under RCP 2.6 emission scenario, relative to base period 1986-2005. By the end of the twenty-first century under RCP 2.6, the projected ensemble median of 95pTOT increase will be from 8% in Northern to 19% in Southern AEZs and/or from 14% in Southern to 20% in Northern AEZs, under RCP 8.5, and medium increase by 17-18 % according to RCP 4.5.

The percentage increase in R95pTOT and R99pTOT is larger than that of PRCPTOT, implying a disproportionally larger contribution to the total precipitation change from an increase in precipitation falling on very wet and extremely wet days. Additionally, models have better agreement in the sign of projected changes in R95pTOT and R99pTOT than in PRCPTOT.

The CDD is projected to increase everywhere by the end of the twenty-first century under all three scenarios, except Southern AEZ where the slight decrease in consecutive dry days is possible under RCP 2.6 low emission scenario. The projections indicate that Northern AEZ will experience the greatest increase of CDD, with CDD by 17% under RCP 8.5, whereas Southern AEZ will experience the decrease of CDD by -1.6% under RCP 2.6 emission scenario, relative to base period 1986-2005. By the end of the twenty-first century under RCP 4.5, the projected ensemble median of CDD increase will be from 3.1% in Northern to 7.8% in Southern AEZs and/or from 12.5% in Southern to 17% in Northern AEZs, under RCP 8.5.

The CWD is projected to decrease everywhere by the end of the twenty-first century under all three scenarios, except Southern AEZ where the slight increase in consecutive wet days is possible under RCP 4.5 medium and RCP 2.6 low emission scenarios. The projections indicate that Northern AEZ will experience the greatest decrease of CWD by 21% under RCP 8.5, whereas Southern AEZ will experience the slight increase of CWD by +2.1% (RCP 4.5) and/or +3.7% (RCP 2.6) emission scenarios, relative to base period 1986-2005. By the end of the twenty-first century under RCP 4.5, the projected ensemble median of CWD decrease will be from 3.5% in Central to 12.5% in Northern AEZs and/or from 10.6% in Southern to 21% in Northern AEZs, under RCP 8.5.

ES.6.3. Climate Change and Agroclimatic Conditions

I. Climate Change and Thermal Resources

The set of temperature – based agroclimatic indices: last (LFD), first (FFD) frost day; frost (FP), frost free (FFP) period; start ($GSS_{5,\ 10,\ 15°C}$), end ($GSE_{5,\ 10,\ 15°C}$), length ($LGS_{5,\ 10,\ 15°C}$) of growing season with T_{avg} above 5°C, 10°C and 15°C; active growing degree days ($AGDD_{5,10°C}$); and effective growing degree days ($EGDD_{5,10°C}$) representing the heat conditions, during the growing season for cool season, warm season, and very warm season agricultural crops across the Republic of Moldova's AEZs were computed from 20-yr daily climatic observed data for a baseline period (1986-2005), observed climate (1961-2014) and for three future 20-yr time periods (2016–2035, 2046–2065, and 2081-2100), based on an ensemble of 21 GCMs for three RCP8.5, RCP4.5 and RCP2.6 emission scenarios of greenhouse gases and aerosols.

Due to climate change is expected a significant increase in the length of the growing season and in the associated available heat. The winter temperature will be less damaging and the frost-free periods longer. In the future, due to the earlier start of spring and autumn elongation, in the Republic of Moldova it can be expected a substantial increase in the FFP. By the end of the century, duration of the FFP in Central and Southern AEZs will increase significantly from 29-31 days (for the scenario RCP 2.6) to 35-37 days (for the RCP 4.5 scenario). The lowest growth from 15 to 32 days is expected across Northern AEZ.

The $LGS_{5°C}$ will increase from 15 (RCP 2.6) to 49-52 (RCP 8.5) days in Central and Southern AEZs, the minimum increase of $LGS_{5°C}$ from 9 (RCP 2.6) to 40 (RCP 8.5) days is projected in Central AEZ. For all AEZs, the $LGS_{5°C}$ will increase, mainly due to earlier start the spring vegetation (from 5 to 22 days in Northern; 6 to 29 days in Central; and 10 to 31 days before in Southern AEZs), while the autumn will finish later than usual from 4 to 18 days in Northern; from 9 to 20 days in Central; and from 9 to 21 days in Southern AEZs by the 2081-2100 in comparison to the 1986-2005 base time period.

The $LGS_{10°C}$ will increase substantially from 16-19 to 43-47 days in Northern and Southern AEZs. The tendency to minimum increase of the growing season with temperatures above 10°C in the Central AEZ will persist, and by the 2081-2100 period, it would be expected that such periods will last from 15 to 40 days longer as compared to the 1986-2005 baseline time period. By the end of the 21th century the length of the period with the average daily temperatures above 15°C will increase substantially from 12 (RCP 2.6) to 35-42 (RCP 8.5) days in Central and Southern regions. In Northern AEZ the highest growth in the $LGS_{15°C}$ is expected with the average daily temperatures above 15°C from 24 days (according to the scenario RCP 2.6) to 51 days (under RCP 8.5) as compared to the 1986-2005 baseline time period.

The $AGDD_{5°C}$ and/or $EGDD_{5°C}$ would increase significantly under RCP 8.5 by 42-43%, respectively by 50-57%, and will make from 4227 and 3322°C for Northern to 5245 and 3825°C for Southern AEZs. The lowest growth is expected according to RCP 2.6 by 11% and respectively by 12-15%, varying from 3589 and 2433°C for Northern, to 4096 and 2861°C for Southern AEZs, relative to the 1986-2005 baseline climate. By the end of 2080s, the $AGDD_{10°C}$ or/and $EGDD_{10°C}$ will increase to a large degree by 45-52 and 72-88% under the RCP 8.5, and will make from 4316 and 2146°C for Northern to 4840 and 2560°C in Southern AEZs. The lowest growth is projected according to the RCP 2.6 scenario by 12-15 and 17-22%, and will make from 3252 and 1392°C for Northern to 3787 and 1747°C in Southern AEZs relative to the 1986-2005 baseline climate.

The $AGDD_{15°C}$ and/or $EGDD_{15°C}$ would increase significantly under RCP 8.5 by 50-73%, respectively by 132-202%, and will make from 3720 and 1200°C for Northern to 4201 and 1546°C for Southern AEZs. The lowest growth is expected according to RCP 2.6 by 14-25% and respectively by 31-45%, varying from 2691 and 576°C for Northern, to 3183 and 873°C for Southern AEZs, relative to the 1986-2005 baseline climate.

II. Climate Change and Humidity Resources

For all three RCPs 8.5, 4.5, 2.6 emission scenarios are expected worsening of the humidity conditions throughout the territory of the RM's AEZs. Reduced rainfall in the summer and autumn period (not compensated by a slight increase in winter and spring precipitation) against a background of rising temperatures will cause the strong moisture deficit and sequential increase of the potential evaporation and accelerate considerably climate aridization process during the growing season in the XXI century.

Potential evaporation is likely to increase by 7-11 per cent during the growing season over the 2016-2035 period, and run up to 42-47 per cent by the 2081-2100 period and make from 1022 mm for Northern to 1312 mm in Southern AEZs under the high emission scenario RCP 8.5. The lowest growth is projected according to the RCP 2.6 scenario, by 10-11 per cent, from 779 mm for Northern, to 990 mm in Southern AEZs, as compared to the baseline climate.

By the 2081-2100 period the climate aridization will be felt during the whole vegetation period (April to September); it will be much more pronounced and may result in values characteristic to the semi-arid climate ($AI = 0.21\text{-}0.50$). Compared to base period (1986-2005), all climatic scenarios applied for the assessment purposes, have demonstrated that the aridity would be highest in July and August (in the case of RCP 8.5 scenario), achieving in respective periods values characteristic to arid climate conditions ($AI = 0.05\text{-}0.20$).

Analysis of data shows that by the 2081-2100 time the drought conditions of $HTC \leq 0.7$ will be observed on the whole territory of Moldova including Northern AEZ (in August). Furthermore, under RCP 8.5 scenario in Central (July, August) and Southern AEZs in July, August, and September those levels can achieve even the values characteristic of the medium drought ($HTC = 0.6$) and strong drought ($HTC \leq 0.5$).

Projected Multi - Model Ensemble Ivanov Index of the Biological Effectiveness of Climate (IBEC) Development throughout the Republic of Moldova, clearly demonstrates the gradual worsening of optimal ecological-climatic characteristics for plant growing of the Republic of Moldova's territory, including the northern areas by the 2081-2100 period especially for RCP 8.5 and 4.5 scenarios.

This result may be useful in further developing of national, regional and sectoral (specifically for agriculture sector) adaptation strategies and plans. Farmers and policymakers may use such information to choose climate adaptation measures such as for example agricultural crop selections. For example, an increasing trend in heat accumulations may be more favorable for vine and fruit production but less favorable for cereal crop production a sharp decrease in grain corn and winter wheat yield being expected in a number of districts of the Republic of Moldova, especially in the Central and Southern areas of existing agricultural regions. A balance should be reached by taking advantage of the increases in growing season length and heat accumulations and managing the risks associated with seasonal water deficits.

ES.6.4. Climate Change Impacts and Vulnerabilities in the Republic of Moldova

I. Climate Change and Major Annual Crop Production

The impact assessment performed on national level allows concluding that the negative effect of global warming, according to the CMIP 5 Ensemble of 21 GCMs for RCP 8.5, RCP 4.5, and RCP 2.6 emission scenarios in the XXI century will not be offset by increase of precipitations. In these circumstances, without undertaking any adaptation measures, the following can be expected by 2100: a significant drop in the productivity for grain corn, from 34% (RCP 2.6) to 67% (RCP 4.5); in winter wheat, from 22% (RCP 2.6) to 46% (RCP 4.5); a medium drop in the productivity for sunflower from 16% (RCP 2.6) to 57% (RCP 8.5), respectively for sugar beet, from 9% (RCP 2.6) to 37% (RCP 8.5); and for tobacco, from 10% (RCP 2.6) to 30% (RCP 8.5), in comparison with the average productivity of the RM's major agricultural crops in the most recent period of 1981-2010. Due to changes in climatic conditions in the RM, by the end of the XXI century, the cultivation of grain corn and winter wheat will be impossible according to the RCP 8.5 high emission scenario.

Additionally, to the national level we have assessed the impact of temperature and precipitation during the growing season on agricultural crops productivity in the RM's territorial administrative units (district level), in order to distinguish the most and least vulnerable districts to climate change.

I.A. Projections of Future Changes in Winter Wheat Yield

According to projections, the most vulnerable districts for cultivation of winter wheat will be Basarabeasca, Taraclia, Cimislia, Causeni, Cahul, and Stefan Voda in Southern, and Dubasari, Anenii Noi, Hincesti, Ialoveni, Nisporeni, Criuleni, Telenesti and Orhei, in Central AEZs, in which productivity of the winter wheat may decrease from 19-26% under RCP

2.6 to 52-63% under RCP 4.5 by 2100. The least vulnerable districts for winter wheat production will be Donduseni, Briceni, Riscani, Soroca, and Singerei in the Northern AEZ; and Ungheni, Calarasi and Soldanesti in Central AEZs, in which productivity of the winter wheat by 2100 could decrease from 8 to 28% under RCP 2.6 and/or from 69 to 94% under RCP 8.5.

I.B. Projections of Future Changes in Grain Corn Yield

Due to climate change the most vulnerable for grain corn cultivation would be the Central and – to a less extent the Northern and Southern AEZs. The most vulnerable districts will be Orhei, Anenii Noi, Straseni, Ialoveni, Nisporeni, Telenesti, Ungheni, Calarasi, Criuleni and Dubasari; and UTA, Basarabeasca, Cahul, Taraclia, and Stefan Voda in Southern AEZ, in which productivity of the grain corn may decrease by 2100 from 28 to 50% (RCP 2.6) and/or up to 58-91% (RCP 4.5). The significant drop in grain corn yield from 65 to 100% under RCP 8.5 emission scenario is projected in Northern AEZ by 2100 relative to 1981-2010 base period. The least vulnerable districts to climate change will be Donduseni, Drochia, Falesti, and Ocnita in Northern; Rezina, and Soldanesti in Central, and Leova in Southern AEZs, in which productivity of the grain corn may decrease by 2100, in dependence of the assessed emission scenario from 7 to 23% (RCP 2.6) and/or from 25 to 49% (RCP 8.5).

Without adaptation, due to changes in climatic conditions in the most districts of the RM, by the end of the XXI century, the cultivation of grain corn and winter wheat will be impossible according to the RCP 8.5 high emission scenario or economically not cost effective under the RCP 4.5 medium emission scenario.

I.C. Projections of Future Changes in Sunflower Yield

The most vulnerable for sunflower cultivation without application of adaptation measures, would be Central AEZ and in less extent Northern and Southern AEZs. According to projections, the most vulnerable districts will be Ialoveni, Hincesti, Straseni, Telenesti, Anenii Noi, Dubasari, and Orhei in Central AEZ, in which productivity of sunflower by 2100 may decrease from 23 to 37% (RCP 2.6) and/or from 44 to 76% (RCP 4.5). The least vulnerable for sunflower cultivation districts will be Floresti, Falesti, Riscani, Briceni, Donduseni, Drochia, Edinet, Ocnita, Singerei, and Soroca in Northern AEZ in which productivity of sunflower may decrease by 2100, from 4 to 15% (RCP 2.6) and/or from 17 to 40% (RCP 4.5). Without adaptation measures due to changes in climatic conditions in the most districts of the RM, by the end of the XXI century, the cultivation of sunflower will be impossible or economically not cost effective according to the RCP 8.5 high emission scenario.

I.D. Projections of Future Changes in Sugar Beet Yield

According to projections, without application of adaptation measures, the most vulnerable districts for sugar beet cultivation will be Glodeni, Drochia, Falesti, Floresti, and Singerei in Northern; Telenesti, Orhei, and Rezina in Central AEZs, in which productivity of sugar beet may decrease by 2100 from 14 to 27% (RCP 2.6) and/or from 65 to 87% (RCP 8.5). The least vulnerable districts for sugar beet cultivation will be Briceni and Donduseni in Northern; and Ungheni in Central AEZs, in which productivity of the sugar beet may increase by 2100 from 2 to 9% (RCP 2.6) and/or from 9 to 34% (RCP 8.5), in comparison with the base period. Increase in the productivity of sugar beet is also projected for Edinet and Ocnita districts in Northern AEZ, however the yield trends in reference period (1981-2010) are statistically significant on the lowest significant level ($p \leq 0.1$), so it can be noted just a tendency to yield increase in these districts.

I.E. Projections of Future Changes in Tobacco Yield

Without application of adaptation measures, the most vulnerable to climate change tobacco areas in the RM would be Northern, Central and to a less extent Southern AEZs. The most vulnerable districts for tobacco cultivation will be Donduseni, Briceni, Ocnita, Edinet, Soroca, Floresti, Riscani, and Glodeni in the Northern; Nisporeni, and Ungheni districts in Central; and Cimislia in Southern AEZs, in which tobacco productivity could decrease from 23 to 56% (RCP 2.6) and/or from 47 to 98% (RCP 4.5). The least vulnerable districts for tobacco cultivation will be Cantemir, Leova, Taraclia and UTA Gagauzia in Southern AEZ, in which productivity of tobacco may increase by 2100 from 9 to 11% (RCP 2.6) and/or from 7 to 34% (RCP 8.5), in comparison with the 1981-2010 reference period. Without adaptation measures, due to changes in climatic conditions, by the end of the XXI century the cultivation of tobacco in Donduseni, Briceni, Edinet, Soroca, Glodeni, Floresti, Ocnita, Riscani, Nisporeni, Ungheni and Cimislia districts will be either impossible according to the RCP 8.5 high emission scenario, or economically not cost effective according to RCP 4.5 medium emission scenarios.

II. Climate Change and Livestock Production

The possible projections in the livestock production (*milk, eggs, wool, beef, pork, mutton and poultry*), due to future climate changes in the RM, have been considered for two alternative scenarios: (1) assuming increase in summer average temperature (Jun, Jul and Aug) and no decrease in the future cereal crops yield – optimistic scenario, and (2) considering increase in summer average temperature (Jun, Jul and Aug) and possible decrease in the yield of the main cereal crops (winter wheat and grain maize) – pessimistic scenario.

II.A. Projections of Future Changes in Milk Production

The analysis of the obtained results revealed that due to the impact of the main climate and crop predictors variables in the RM, the milk production by 2035 could decrease from 24% (RCP 2.6) to 29% (RCP 8.5), without changes in cereal crop yield (optimistic scenario), respectively from 33% (RCP 2.6) to 41% (RCP 8.5), by considering projections of changes in the yield of winter wheat and grain maize (pessimistic scenario). In comparison with the 1981-2010 reference period, by 2065 the milk production may decrease depending on the assessed emission scenario, from 33% (RCP 2.6) to 66% (RCP 8.5) under the optimistic scenario, and respectively from 45% (RCP 2.6) to 91% (RCP 8.5) under the pessimistic scenario. The maximum values of milk production decrease may be reached by 2100. Due to changes in values of main climate predictors (T_{Jun}, T_{Jul} T_{Aug} and cereal crop yield) the milk production will decrease from 30% (RCP 2.6) to 60% (RCP 4.5) under optimistic scenario, respectively from 41% (RCP 2.6) to 82% (RCP 4.5) according to the pessimistic scenario.

II.B. Projections of Future Changes in Eggs Production

Due to the impact of main climate and crop predictor's variables in the RM, the eggs production by 2035 could decrease from 15% (RCP 2.6) to 18% (RCP 8.5), under the optimistic scenario, respectively from 17% (RCP 2.6) to 21% (RCP 8.5), according to the pessimistic scenario. In comparison with the 1981-2010 reference period, by 2065 the eggs production may decrease from 21% (RCP 2.6) to 42% (RCP 8.5) under the optimistic scenario, respectively from 24% (RCP 2.6) to 51% (RCP 8.5) according to pessimistic scenario. The maximum values of eggs production decrease could be reached by 2100, from 20% (RCP 2.6) to 79% (RCP 8.5) under the optimistic scenario, respectively from 22% (RCP 2.6) to 89% (RCP 8.5) according to the pessimistic scenario.

II.C. Projections of Future Changes in Wool Production

A greater frequency of drought, pasture deterioration, higher summer temperatures and an increased incidence of pests and diseases under warmer climates are likely to put further physiological stress on sheep. This stress may be alleviated, to some degree, by higher winter temperatures and lengthening of warm seasons, both of which have the potential to improve wool quality. For wool production in the RM, a slight decrease by 5-6% in the 2016-2035 period is projected under the optimistic scenario, respectively a decrease by 11-14% under the pessimistic scenario. In comparison with the 1981-2010 reference period, by 2065 the wool production may decrease from 7% (RCP 2.6) to 13% (RCP 8.5) under the optimistic scenario, respectively from 15% (RCP 2.6) to 29% (RCP 8.5) according to the pessimistic scenario. The maximum values of wool production reduction could be reached by the 2100, from 6% (RCP 2.6) to 25% (RCP 8.5) under the optimistic scenario, respectively from 13% (RCP 2.6) to 44% (RCP 8.5) according to the pessimistic scenario.

II.D. Projections of Future Changes in Beef Production

For beef production in the RM by 2035, when assessing the combined effect of T_{Jun}, T_{Jul}, T_{Aug} and cereal crop yield, a decrease is expected in productivity from 45% (RCP 2.6) to 55% (RCP 8.5) under the optimistic scenario, respectively from 62% (RCP 2.6) to 77% (RCP 8.5) under the pessimistic scenario. By 2065, a decreasing trend will persist in beef production due to climate change, increase in summer average temperature and decrease in cereal crop productivity. Severe decrease in beef production, from 62% (RCP 2.6) to 82% (RCP 4.5) is expected under the optimistic scenario. While according to the pessimistic scenario, i.e. by considering the projected changes in the yield of the main cereal crops, under the RCP 2.6 low emission scenario the animal breeding will be economically not cost-effective, while under the RCP 8.5 (high) and RCP 4.5 (medium) emission scenarios, even impossible in the conditions of the RM. The maximum values of beef production decrease may be reached by 2100, under the optimistic scenario by 57% (RCP 2.6), while according to the pessimistic scenario under all three RCP emission scenarios the cattle breeding will be impossible in the RM. In case the predicted climate change occurs, the current beef production potential can be maintained only if supplemental feed is offered; this factor would reduce significantly the economic efficiency of cattle production and may have an impact on beef quality as well.

II.E. Projections of Future Changes in Pork Production

The climate change with rising mean temperatures may cause a permanent stress load for pigs, especially in continental summer or warmer climate areas. Due to warming and decrease in cereal crop productivity, pork production in RM by 2035 may decrease from 32% (RCP 2.6) to 38% (RCP 8.5) under the optimistic scenario, and respectively from 44% (RCP 2.6) to 55% (RCP 4.5) under the pessimistic scenario. In comparison with the 1981-2010 reference period, by 2065 the pork production may decrease, depending on the assessed emission scenario, from 43% (RCP 2.6) to 86% (RCP 4.5) under the optimistic scenario, and respectively from 60% (RCP 2.6) to 81% (RCP 4.5) under the pessimistic scenario. The maximum values of pork production decrease may be reached by 2100, from 39% (RCP 2.6) to 77% (RCP 4.5) under the optimistic scenario. While according to the pessimistic scenario, i.e. by considering the projected changes in the yield of the main cereal crops, under the RCP 2.6 low emission scenario the swine breeding will be economically not cost-effective, and/or even impossible in the conditions of the RM under the RCP 8.5 (high) and RCP 4.5 (medium) emission scenarios.

II.F. Projections of Future Changes in Mutton Production

For mutton production by 2035, when assessing the combined effect of T_{Jun}, T_{Aug} and cereal crop yield, a slight decrease in the productivity is expected, from 13% (RCP 2.6) to 17% (RCP 8.5) under the optimistic scenario, respectively from 23% (RCP 2.6) to 29% (RCP 8.5) under the pessimistic scenario. In comparison with the 1981-2010 reference period by 2065, the mutton production may decrease, depending on the assessed emission scenario, from 20% (RCP 2.6) to 40% (RCP 8.5) under the optimistic scenario, and respectively from 33% (RCP 2.6) to 65% (RCP 8.5) under the pessimistic scenario. The maximum values of mutton production decrease may be reached by 2100. Due to changes in values of main climate predictors (T_{Jun}, T_{Aug} and reduced yield of the main cereal crops), the mutton production could decrease from 18% (RCP 2.6) to 78% (RCP 8.5) under the optimistic scenario, and respectively from 29% (RCP 2.6) to 59% (RCP 4.5) according to the pessimistic scenario.

II.G. Projections of Future Changes in Poultry Production

The analysis of the obtained results revealed that due to the impact of the main climate (T_{Jun}, T_{Jul}) and crop yield predictors variables in the RM, the poultry production by 2035 could decrease from 19% (RCP 2.6) to 21% (RCP 8.5) under the optimistic scenario, respectively from 28% (RCP 2.6) to 33% (RCP 8.5) under the pessimistic scenario. In comparison with the 1981-2010 reference period, by 2065 the poultry production may decrease depending on the assessed emission scenario from 25% (RCP 2.6) to 50% (RCP 8.5) under the optimistic scenario, respectively from 37% (RCP 2.6) to 76% (RCP 8.5) under the pessimistic scenario.

The maximum values of poultry production decrease could be reached by 2100. Due to changes in values of main climate predictors (T_{Jun}, T_{Jul}, T_{Aug}) and reduced yield of the main cereal crops, the poultry production will decrease from 24% (RCP 2.6) to 94% (RCP 8.5) under the optimistic scenario, and respectively from 34% (RCP 2.6) to 68% (RCP 4.5) under the pessimistic scenario. Furthermore, according to the pessimistic scenario, i.e. by considering the projected changes in the yield of the main cereal crops, under the RCP 4.5 (medium) emission scenario the poultry breeding will be economically not cost-effective, while under the RCP 8.5 (high) emission scenarios, even impossible in the conditions of the RM.

III. Climate Change and Water Resources

In the presented case study, calculations and mapping results are displayed on average annual water runoff in the RM induced by climate change for three time periods: years 2035 (2016-2035), 2065 (2046-2065) and 2100 (from 2081 to 2100), projected by the CMIP5 ensemble of 21 GCMs conditioned by three representative pathways scenarios (RCP 8.5, RCP 4.5 and RCP 2.6) as compared to the base period (1981 – 2010), for three AEZs of the Republic of Moldova (Northern, Central, and Southern AEZs).

Upon modelling of the climatic flow layer for the base period, it is found that its mean value for the entire country is 32.04 mm, the minimum - 9.33 mm and maximum - 70.82 mm. The Northern AEZ shows a mean climate annual flow of 42.18 mm, maximum - 70.82 mm and minimum - 21.29 mm. Central AEZ shows a flow of 27.61 mm as mean value, while the maximum is - 66.96 mm, and the minimum - 13.16 mm. The Southern AEZ shows values of 16.56 mm, 36.41 mm and 9.33 mm, respectively. These values are sufficient to ensure the contemporary hydrological regime of small rivers in Moldova, but the distribution of the flow throughout the year shows, especially in the summer (due to frequent droughts), a flow, which is well below the norm, which most likely will lead to drying up of rivers, especially in the south of the country.

According to the results obtained for the years 2100, projections of climate models ensemble assessed for RCP8.5 scenario envisage a dramatic reduction in mean annual flow layer, as compared to the base period of about 45.0% in Northern AEZ, 54.8% in Central AEZ, respectively 64.5% in Southern AEZ; additionally, the climate models ensemble within RCP2.6 scenario is much more optimistic, ranging from an increase in mean annual flow layer of about 8.1% in Southern AEZ up to 23.5% in Northern AEZ.

IV. Climate Change and Forestry Fire Risk Assessment

In order to estimate the possible changes in forest fire risk conditions, the Angstrom index, (I) projections were modelled for two 30-year periods, 2021-2050, and 2071-2100, according to the ensemble of EURO-CORDEX RCMs for RCP 8.5 and RCP 4.5 scenarios in the 21st century. A set of maps for better spatial and temporal visualization of the forest fire risk throughout the RM over the 1971-2000 base period, and 30-year periods, 2021-2050, and 2071-2100, according to the ensemble of EURO-CORDEX RCMs for RCP 8.5 and RCP 4.5 scenarios was developed. A significant correlation between meteorological parameters and forest fire occurrence was found, which opens a possibility for further investigation and analysis of geophysical and anthropogenic driven factors that can influence disaster occurrence.

The assessment of Angstrom index has shown that the risk of fire in summer will become more pronounced. According to the Angstrom index, in the 1966-2015 the fire conditions were favourable ($I= 3.0<I<2.5$) for July (Comrat), and August (Comrat, and Chisinau). The values of index close to the favourable range, 3.1-3.2, for this period were registered in Leova, Dubasari, Baltata, Falesti and Cahul. The values of the *CLTS* index of Angstrom index, on average for 1966-2015, for the July, throughout the territory of the RM, were statistically significant; they had a negative sign and varied from -0.15/10 years to 0.20/10 years, while R^2 varied from 19% to 30%, showing an increase in the risk of forest fire occurrence in the region for the summer season. The value of the determination factor, R_r^2 of 23-38%, was higher for August with the same *CLTS* from -0.15/10 years to 0.21/10 years, which shows a higher statistical significance of the conclusions on changes towards the risk of forest fire occurrence in the region for the summer season on the territory of the RM, especially during the July and August.

In the 2021-2050 time period, according to the ensemble of EURO-CORDEX RCMs for both scenarios, over the warm period of the year, forest fire risk conditions described as "conditions favourable for fires" ($I = 3.0<I<2.5$) is expected, and "conditions more favourable for fires" ($A = 2.5<I<2.0$), depending on the scenario of greenhouse gas emissions, the *I* index in both scenarios will vary from 3.5 to 2.5 (July) and 3.2 to 2.3 (August), while in the 1971-2000 base period, the values of the Angstrom index in summer are within the limits when the conditions for the occurrence of fires are unfavourable ($I = 4.0<I<3.0$). In July, according to the *I* index, more favourable conditions for forest fires are expected in Leova, Comrat and Cahul (South AEZ), while in Briceni, Soroca and Camenca (Northern AEZ) the conditions for the fire occurrence will be unfavourable. In August, more favourable conditions for the occurrence of forest fires are possible in Leova, Comrat and Cahul (Southern AEZ), as well as in Dubasari, Balti and Chisinau (Central AEZ) and only in Briceni the conditions for the occurrence of fires will be unfavourable.

By the end of the century, over the period 2071-2100 the trend for growth of forest fire risk conditions during the warm period (July, and August) will be maintained, and will be much higher for the RCP 8.5 with strong greenhouse gas emissions; furthermore, the fire risk meteorological conditions will be possible from June in Ribnita, Dubasari, Baltata, Leova, Comrat and Cahul and will continue until September, covering almost the entire territory of the Republic of Moldova, except for Briceni, Soroca, Camenca, Bravicea, and Cornesti. In July, according to the scenario of RCP 8.5, more favourable conditions for forest fires occurrence are expected in Ribnita, Balti, Falesti (Northern AEZ), Bravicea, Dubasari, Baltata and Chisinau (Central AEZ), Leova, Comrat and Cahul (South AEZ) and only in Briceni conditions for the occurrence of forest fires will be unfavourable. In August, according to the RCP 8.5 scenario, the favourable and more favourable meteorological conditions for the occurrence of forest fires are possible throughout the territory of the Republic of Moldova, including Dubasari, and Baltata. For the RCP 4.5, with average greenhouse gas emissions, the favourable and more favourable forest fire risk meteorological conditions are expected on most of the territory of the Republic of Moldova only in July and August.

Analysing past and predicting future fires are crucial for policy development and forest management practices to prevent and mitigate fires. The use of the indices, as a fire occurrence likelihood measure, was illustrated here in forest fire risk case study in the Republic of Moldova. The results from this study can be used for creation of the platform for fire management operational framework that can be used as a tool for decision making prevention, detection and monitoring of forest fire hazards at both the district and national levels in the Republic of Moldova. Such a programme would be in line with the forest fire risk assessment and management practices that are currently being developed internationally.

V. Potential Impacts of Climate Change on Bioclimatic Conditions

V.A. Projections of Future Changes in Bodman Index (BI)

In order to estimate the possible changes in bioclimatic conditions, the Bodman severity index projections were modelled for two 30-year periods, 2021-2050, and 2071-2100, according to the ensemble of EURO-CORDEX RCMs for RCP 8.5 and RCP 4.5 scenarios in the 21st century.

Over the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs, "moderate-severe" ($2<S<3$) and "mildly severe" ($1<S<2$) winters are expected. A differentiated growth in the Bodman severity index for winter conditions, S (1), is expected, depending on the RCPs, from 4 to 53% (RCP 8.5) and/or from 7 to 48% (RCP 4.5) in January and from 1 to 45% in December, according to two RCPs in different regions of Moldova. In February, March and November, the maximum increase in Bodman severity index for winter conditions, S (1), will be 34-39%.

During the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs, "moderately severe" ($2<S<3$) and "mildly severe" ($1<S<2$) winters are expected. The trend towards increase in the Bodman severity index for winter conditions, S (1), will continue, and will be higher for RCP 8.5, from 12 to 40% (RCP 4.5) and/or from 2 to 26% (RCP 8.5) in January and from 2 to 37% (RCP 4.5) and/or from 2 to 25% (RCP 8.5) in December, as compared to the base period, 1971-2000. In different regions of the RM, in February, March and November, a maximal growth in S (1), from 19% (RCP 8.5) to 30% (RCP 4.5) is possible.

V.B. Projections of Future Changes in Effective Temperature (ET)

In the 2021-2050 period, according to the ensemble of EURO-CORDEX RCMs for both RCPs, over the cold period of the year, a thermal feeling described as "moderate" (*ET = +6°C ... 0°C*) is expected, while *ET* index values will vary from + 1.7°C (Briceni) to + 3.0°C (Cahul). As compared with the base period, 1971-2000, in 2021-2050, over the cold season, a differentiated growth in the *ET* index is expected from +0.9°C to +1.3°C (RCP 8.5) and/or from +1.5°C to +1.8°C (RCP 4.5) in January and from +1.1°C to +1.5°C in December, respectively in different regions of the RM. In February, maximum increase in the *ET* index from +2.2°C to +2.8°C as compared to the base period, 1971-2000, is possible.

Over the warm season of the period 2021-2050, according to the ensemble of regional EURO-CORDEX models for both RCPs, the thermal feelings described as "moderately warm" (*ET = +12°C ... +18°C*) and "warm" (*ET = +18°C ... +24°C*), with comfortable load are expected. The values of the *ET* index will vary from +17.0°C in Briceni to +18.8°C in Comrat, respectively. In comparison with the base period, 1971-2000, over the period 2021-2050, according to both RCPs, over the warm period of the year (May to September), the *ET* index is expected to increase from +0.7°C to +1.1°C in July and September in different regions of the RM. In May and June, the maximum growth of the *ET* index is possible, from +1.1°C to +1.5°C as compared to the base period, 1971-2000.

By the end of the century, on the territory of the RM, according to the ensemble of EURO-CORDEX RCMs for both RCPs, bioclimatic conditions described as "moderate" (*ET = +6°C ... +0°C*) are expected during the cold period. The values of the *ET* index will vary according to the RCP 4.5 from +2.5°C (Briceni) to +4.0°C (Comrat) and/or from +4.8°C (Briceni) to +5.8°C (Comrat) according to RCP 8.5. The trend towards increase in the comfort of thermal feeling during the cold period of the year will be maintained, which will be significantly higher for RCP 8.5, from +2.6°C to +3.0°C (RCP 4.5) and/or from +4.4°C to +5.4 (RCP 8.5) in January and from +1.8°C to +2.5°C (RCP 4.5) and/or from +3.9°C to +4.5°C (RCP 8.5) in December, as compared to the base period, 1971- 2000, in different regions of the RM. In February, the *ET* index is expected to grow from +2.9°C to +3.7°C (RCP 4.5) and/or from +4.9°C to +6.1°C (RCP 8.5).

During the warm season of the year, over the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs, bioclimatic conditions described as "warm" with comfortable load are expected on most of the territory of the RM (*ET = +18°C ... +24°C*). The *ET* values will vary from +17.4°C (RCP 4.5) and/or +19.1°C (RCP 8.5) in Briceni to +19.2°C (RCP 4.5) and/or +20.9°C (RCP 8.5) in Comrat. The trend towards an increase in the *ET* index during the warm period of the year will be maintained; it will be significantly higher for RCP 8.5, from +1.3°C to +1.6°C (RCP 4.5) and/or from +3.0°C to +3.3°C (RCP 8.5) in July and from +1.2°C to +1.6°C (RCP 4.5) and/or from +3.0°C to +3.4°C (RCP 8.5) in September, as compared to the base period, 1971-2000, in different regions of the RM. In June, the maximum growth of the *ET* index is expected, from +1.7°C to +2.1°C (RCP 4.5) and/or from +3.2°C to +3.6°C (RCP 8.5).

V.C. Projections of Future Changes in Equivalent-effective temperature of Miserand (EET)

Over the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs, thermal feelings described as "very cold" (*EET = -18°C ... -24°C*) are expected during the cold season of the year, while the values of the *EET* index will vary from -20.8°C (Briceni) to -18.8°C (Comrat).

In comparison with the base period, 1971-2000, over the period 2021-2050, a differentiated growth of the *EET* index is expected during the cold season, depending on RCPs, from +0.1°C to +1.1°C (RCP 8.5) and/or from +0.7°C to +1.9°C (RCP 4.5) in January and from +0.1°C to +1.5°C in December, according to the two scenarios, in different regions of the RM.

Over the warm season of the year, during period 2021-2050, according to the ensemble of regional EURO-CORDEX models for both RCPs scenarios, bioclimatic conditions descried as "moderately cool" (*EET = 0°C ... +6°C*) are expected. The values of the *EET* index will vary, on the average for the warm period, from +3.1°C in Briceni to +6.0°C in Comrat. In comparison with the base period, 1971-2000, over the period 2021-2050, a differentiated growth of the *EET* index for the warm season of the year (from May to September) is expected, according to both RCPs, from +0.1°C to +1.3°C in July and September in different regions of the RM. In May and June, the maximum increase in the *EET* index is possible, from +0.3°C to +2.0°C, as compared to the base period, 1971-2000.

In the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs, bioclimatic conditions characterized as "cold" (*EET = -12°C ... -18°C*) are expected during the cold season, while in some regions, for RCP 4.5, close to "very cold" (*EET = -18°C ... -24°C*) conditions are expected. The values of the *EET* index will vary during the cold period from -19.4°C (Briceni) to -17.3°C (Comrat) according to the RCP 4.5 and/or from -16.0°C (Briceni) to -14.6°C (Comrat) according to the RCP 8.5 scenario. The trend towards an increase in the *EET* index for the cold period of the year will be maintained; the index will be significantly higher for a RCP with high greenhouse gas emissions, from +1.8°C to +3.8°C (RCP 4.5) and/or from +5.0°C to +7.1°C (RCP 8.5) in January and from +1.1°C to +3.1°C (RCP 4.5) and/or from +3.9°C to +5.9°C (RCP 8.5) in December, as compared to the base period, 1971-2000, in different regions of the RM.

During the warm season of the year, for the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs, bioclimatic conditions described as "cool" (*EET = +6°C ... +12°C*) are expected. The values of the *EET* index will vary from +4.1°C (RCP 4.5) and/or +6.7°C (RCP 8.5) in Briceni to +6.8°C (RCP 4.5) and/or +9.5°C (RCP 8.5) in Comrat. The trend towards an increase in the *EET* index for the warm period of the year will be maintained; it will be significantly higher for RCP 8.5, from +0.8°C to +2.2°C (RCP 4.5) and/or from +3.5°C to +5.1°C (RCP 8.5) in July and from +0.3°C to +1.9°C (RCP 4.5) and/or from +3.2°C to +5.0°C (RCP 8.5) in September, as compared to the base period, 1971- 2000, in different regions of the RM. In June, the maximum *EET* index is expected to grow from +1.6°C to +2.8°C (RCP 4.5) and/or from +3.8°C to +5.4°C (RCP 8.5).

V.D. Projections of Future Changes in Normally Equivalent Effective Temperature (NEET)

Over the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs, thermal feelings described as "cold discomfort" (*NEET = -18°C ... 0°C*) are expected during the cold period of the year, while the values of the *NEET* index will vary from -9.6°C (Briceni) to -8.0°C (Comrat). In comparison with the base period, 1971-2000, in 2021-2050 a differentiation in the *NEET* index is expected during the cold season, depending on the scenario of greenhouse gas emissions, from +0.1°C to +0.6°C (RCP 8.5) and/or from +0.6°C to +1.6°C (RCP 4.5) in January and from +0.1°C to +1.2°C in December, according to two RCPs in different regions of the RM. In some districts, such as: Bravicea, Dubasari, Baltata, Falesti, Comrat, the winter conditions are getting more severe and the *NEET* index is decreasing from -0.1°C to -0.8°C, in comparison with the base period, 1970-2000. In February, for both RCPs, a maximum increase in the *NEET* index, from +1.0°C to +2.7°C, as compared to the base period, 1971-2000, is possible.

During the warm period of the year (May to September) in 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs, bioclimatic conditions described as "cool" (*NEET = +6°C ... +12°C*) are expected. The values of the NEET index will vary, on the average for the warm period, from +9.5°C in Briceni to +11.8°C in Comrat, with a maximum in Dubasari, +11.9°C. In comparison with the base period, 1971-2000, in 2021-2050 a differentiated growth of the *NEET* index over the warm period of the year (from May to September) is expected, according to both RCPs, from +0.2°C to +1.0°C in July and September in different regions of the RM. In May and June, a maximum increase in the *NEET* index, up to +1.6°C as compared to the base period, 1971-2000, is possible.

Over the 2071-2100 period, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, bioclimatic conditions described as "cold discomfort" (*NEET = -18°C ... 0°C*) are expected during the cold season of the year. The values of the *NEET* index will vary during the cold period from -8.5°C (Briceni) to -6.8°C (Comrat) according to the RCP scenario 4.5 and/or from -5.8°C (Briceni) to -4.7°C (Comrat) according to the RCP scenario 8.5. The trend towards increase in *NEET* index over the cold season will continue; it will be significantly higher for a RCP 8.5, from +1.4°C to +3.1°C (RCP 4.5) and/or from +4.0°C to +5.7°C (RCP 8.5) in January and from +0.9°C to +2.4°C (RCP 4.5) and/or from +3.1°C to +4.7°C (RCP 8.5) in December, as compared to the base period, 1971-2000, in different regions of the RM. In February, the maximum increase in the *NEET* index, from +2.2°C to +4.0°C (RCP 4.5) and/or from +4.7°C to +6.6°C (RCP 8.5), is expected.

Over the warm period of the year, in 2071-2100, according to the ensemble of EURO-CORDEX RCMs, bioclimatic conditions described as "moderately warm, comfortable" (*NEET = + 2°C ... +24°C*), for the RCP 8.5, are expected, while in case of the RCP 4.5, on most of the territory of the RM, cooler bioclimatic conditions, described as "cool", are expected (*NEET = +6°C ... +12°C*). The values of the *NEET* index will vary depending on the RCPs, from +10.3°C (RCP 4.5) and/or +12.4°C (RCP 8.5) in Briceni to +12.5°C and/or +14.6°C in Cahul, respectively. The trend towards an increase in the *NEET* index of the warm season will be maintained; it will be significantly higher for the RCP 8.5, from +0.6°C to +1.7°C (RCP 4.5) and/or from +2.8°C to +4.1°C (RCP 8.5) in July and from +0.4°C to +1.6°C (RCP 4.5) and/or from +2.6°C to +4.0°C (RCP 8.5) in September, as compared to the base period, 1971-2000, in different regions of the RM. In June, a maximum increase in the *NEET* index, from +1.3°C to +2.2°C (RCP 4.5) and/or from +3.0°C to +4.3°C (RCP 8.5) is expected.

V.E. Projections of Future Changes in Radiation-Equivalent Effective Temperature (REET)

Over the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for RCPs scenarios, the thermal feelings described as "very cold" (*REET* = -8°C ... -3°C) are expected during the cold period of the year, while the REET index values will vary from -5.2°C (Briceni) to -3.6°C (Comrat). As compared to the base period, 1971-2000, in 2021-2050 a differentiated growth in the *REET* index over the cold season is expected, depending on the RCPs, from +0.1°C to +0.9°C (RCP 8.5) and/or from +0.6°C to +1.6°C (RCP 4.5) in January and from +0.1°C to +1.2°C in December, according to two scenarios in different regions of the RM. In February, a maximum increase in the *REET* index is possible, from +1.1°C to 2.8°C, as compared to the base period, 1971-2000.

Over the warm period of the year, during the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs, recreational and climatic conditions described as "moderately cool" (*REET = +12°C ... 17°C*) are expected. The values of the *REET* index will vary, on average over the warm period, from +14.6°C in Briceni to +17.0°C in Comrat. As compared to the base period, 1971-2000, in 2021-2050 a differentiated growth is expected in the *REET* index during the warm period of the year (from May to September), according to both RCPs, from +0.2°C to +1.1°C in July and September in different regions of the RM. In May, the maximum growth in the *REET* index, from 0.5°C to +1.7°C as compared to the base period, 1971-2000, is possible.

Over the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs, bioclimatic conditions described as "cold" (*REET = -3°C ... +2°C*) are expected during the cold season, while in certain districts, for the RCP 4.5, bioclimatic conditions described as close to "very cold" (*REET = -8°C ... -3°C*) are expected. The *REET* index values will vary during the cold period from -4.1°C (Briceni) to -2.3°C (Comrat) according to the RCP 4.5 scenario and/or from -1.2°C (Briceni) to -0.1°C (Comrat) according to the RCP 8.5 scenario. In the period 2071-2100, the trend towards an increase in the *REET* index during the cold period will be maintained; it will be significantly higher for the RCP 8.5, from +2.0°C to +3.2°C (RCP 4.5) and/or from +4.2°C to +5.9°C (RCP 8.5) in January and from +0.9°C to +2.5°C (RCP 4.5) and/or from +3.2°C to +4.9°C (RCP 8.5) in December, as compared to the base period, 1971-2000, in different districts of the RM. In February, the maximum expected growth in the *REET* index, from +2.3°C to +4.2°C (RCP 4.5) and/or from +4.9°C to +6.8°C (RCP 8.5), is expected.

Over the warm period of the year in 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs, recreational and climatic conditions described as "cool" (*REET = +17°C ... 21°C*) are expected. The values of the *REET* index will vary from +15.4°C (RCP 4.5) and/or +17.6°C (RCP 8.5) in Briceni to +17.7°C and/or +19.9°C, respectively, in Cahul. The trend towards an increase in the *REET* index during the warm period will be maintained; it will be significantly higher for the RCP 8.5, from +0.7°C to +1.8°C (RCP 4.5) and/or from +2.9°C to +4.2°C (RCP 8.5) in July and from +0.5°C to +1.7°C (RCP 4.5) and/or from +2.7°C to +4.2°C (RCP 8.5) in September, as compared to the base period, 1971-2000, in different districts of the RM. In June the maximum growth of the *REET* index, from +1.3°C to +2.3°C (RCP 4.5) and/or from +3.1°C to +4.5°C (RCP 8.5) is expected.

V.F. Projections of Future Changes in Biological Active Temperature (BAT)

In the 2021-2050 period, according to the ensemble of EURO-CORDEX RCMs for both RCPs, thermal feelings described as "severe temperature effects" (*BAT = 0°C ... +5°C*) are expected, while the values of *BAT* index will vary from +1.3°C (Briceni) to +2.6°C (Comrat). In comparison with the base period, 1971-2000, in 2021-2050 a slight increase in climate comfort is expected according to *BAT* index for the cold season, depending on the scenario of greenhouse gas emissions, from +0.1°C to +0.7°C (RCP 8.5) and/or from +0.4°C to +1.2°C (RCP 4.5) in January and from +0.1°C to +1.0°C in December, according to two scenarios in different regions of the RM.

During the warm period of the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs, bioclimatic conditions described as "comfortable temperature effects" (*BAT = +10°C ... 20°C*) are expected. The BAT index values will vary, on the average for the warm period from +16.6°C in Briceni to +18.5°C in Comrat. In comparison with the base period, 1971-2000, over the period 2021-2050 a differentiated growth of the *BAT* index for the warm period of the year (from May to September) is expected, according to both representative development pathways, from +0.1°C to +0.9°C in July and September in different regions of the RM. In May, the maximum growth of the *BAT* index, from +0.1 to +1.3°C as compared to the base period, 1971-2000, is possible.

In the 2071-2100 period, according to the ensemble of EURO-CORDEX RCMs for the RCP 4.5, bioclimatic conditions described as "severe temperature effects" (*BAT* = 0°C ... +5°C) are expected during the cold period, while for the RCP 8.5 "moderate temperature effects" (*BAT = +5°C ... +10°C*) are expected. The values of *BAT* index will vary during the cold period from +2.2°C (Briceni) to +3.5°C (Comrat) according to the RCP 4.5 and/or from +4.4°C (Briceni) to +5.3°C (Comrat) according to the RCP 8.5.

Over the warm season of the year, during period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs, recreational and climatic conditions are expected that are described as "comfortable temperature effects" (*BAT = +10°C ... +20°C*). The *BAT* index values will vary during the warm period from +17.2°C (Briceni) to +19.0°C (Comrat) according to the RCP 4.5 and/or from +18.9°C (Briceni) to + 20.7°C (Comrat) according to the RCP 8.5. The trend towards an increase in the BAT index during the warm period of the year will be maintained; it will be higher for RCP 8.5, from +0.5°C to +1.4°C (RCP 4.5) and/or from +2.3°C to + 3.5°C (RCP 8.5) in July and from +0.4°C to +1.3°C (RCP 4.5) and/or from +2.1°C to +3.2°C (RCP 8.5) in September, as compared to the base period,1971-2000, in different districts of the RM. In June, the maximum growth of the *BAT* index, from +1.0°C to +1.8°C (RCP 4.5) and/or from +2.4°C to +3.5°C (RCP 8.5), is expected.

VI. Potential Impact of Climate Change on Health

VI.A. Projections of Future Changes in Diarrhoea Incidence

The analysis of projections on future changes in the incidence of diarrhoea cases in the RM in the short term (2016-2035) reveals an essential increase of diarrhoea cases in children during September (44-56 cases), with higher values in the global scenario of greenhouse gas emissions RCP 8.5. In the medium term (2046-2065), the projections of future changes show an increase in the number of diarrhoea cases, especially for children, both in September (for all scenarios, with a larger number in the RCP8.5 and in October in the RCP 8.5); in the general population a large number of cases are projected in July and September, in the RCP 8.5 and RCP 4.5 scenarios as well.

When analysing the long-term projections (2081-2035), the highest number of diarrhoea cases is expected in July in total population (about 232 cases), but also an impressive number (186 cases) is expected in October in the RCP 8.5. The RCP 4.5 provides for fewer cases, about 55 cases each month. The Long-term projections show diarrhoea in adults in May (59 cases) as well in the RCP 8.5 scenario. Over the same period, a larger number diarrhoea cases are expected in children in September (about 215 cases) and in October (176 cases) in the RCP 8.5.

VI.B. Projections of Future Changes in Cardiovascular, Respiratory, and Digestive Diseases

The number of deaths due to circulatory diseases during summer shows a moderately strong correlation with the air temperature in June ($r=0.70$, $p<0.05$). The R^2 coefficient shows that air temperature accounts for 49% of the variability of deaths for the summer of 2007. The trend of deaths shows an increase of 26 cases per year ($Y=175.64+26.21*T_{Jun}$).

Deaths resulting from digestive diseases during the warm period show a moderately strong correlation with the May precipitation ($r=0.74$, $p<0.01$). The R^2 coefficient shows that precipitation accounts for 55.3% of the variability of deaths due to digestive diseases. The trend shows an annual decrease by 0.59 cases ($Y=228.04+0.59*P_{May}$).

The deaths resulting from respiratory illnesses during the cold period show a moderately strong reverse correlation with the precipitation in January ($r=-0.7$, $p<0.05$). The R^2 coefficient shows that the precipitation during the cold period of the year accounts for 49% of the variability of deaths due to respiratory diseases. The trend in the number of deaths shows an annual decrease by 0.43 cases ($Y=134.878 - 0.42761*P$).

In the case of deaths from the three natural focal diseases (calculated on the basis of data for 2001-2010), the analysis of projections on future changes shows a more pronounced increase in circulatory diseases in summer, especially in long-term climate change projections (2081-2100) with higher values in the RCP 8.5 scenario.

The projections of future changes, based on the 1986-2005 reference period on deaths, show an increase in the number of deaths due to circulatory diseases during summer. According to the RCP 8.5 scenario, in long-term perspectives (2081-2100), the number of deaths will increase in response to high temperatures.

ES.7. Other Information

ES.7.1. Streamlining Climate Change into Social, Economic and Environmental Policies

According to the Development Strategy 2020 of the Republic of Moldova, “the medium and long term strategic vision of the Government is the reconciliation between the need for accelerated economic development and environmental protection in accordance with the European standards. This will be achieved through: (i) attaining a rate of economic development allowing to finance environmental protection measures, and (ii) balanced regulation of the business environment, both in terms of economic impact, and environmental impact.” The commitment to implement European climate change mitigation standards has been set forth in the Association Agreement between the European Union and the Republic of Moldova, Chapter 17. The Republic of Moldova committed to progressively harmonize its legislation with the EU legislation, as well as international instruments in climate change. Meanwhile, in September 2015 the Republic of Moldova has developed and presented to the XXI Conference of the Parties the Intended National Determined Contribution (INDC) for the new climate Paris Agreement, and ratified it in 2017. It should be noted that Moldova’s climate change mitigation goals are being achieved by implementation of economic, social and environmental priority policies approved prior to the signing of the Moldova - EU Association Agreement and declaring the country’s INDC. In this respect a series of laws and strategies concerned were approved. Also, climate change mitigation continues to be reflected in a number of the country’s policies that are currently being developed or drafted for public debate.

ES.7.2. Activities Associated with Climate Change Mitigation Related Technology Transfer

The IPCC identifies three major dimensions needed to ensure the effectiveness of technology transfer: capacity building, enabling environment, technology transfer mechanisms.

Capacity building. The following actions were undertaken to build the capacity for innovation and technology transfer geared to reducing GHG emissions:

- the Innovation and Technology Transfer Agency (AITT) has been created in 2004;
- the Organization for Small and Medium–Sized Enterprises Development (ODIMM) is operational in the RM;

- creation of industrial parks is in full swing in the RM, nine parks and eight innovation incubators being already operational;
- since 22 September 2011, the RM is a partner of "Enterprise Europe Network".

Acknowledging the contribution of the aforementioned structures to the country's capacity building towards technology transfer, it should be noted that their contribution to promoting of GHG emissions mitigation technologies is relatively modest. A much more significant impact towards of such technologies transfer was achieved as a result of the Energy Efficiency Agency (EEA) establishment in 2010, and of the Energy Efficiency Fund (EEF), established in 2012. Significant contribution to capacity building was also made by the MoSEFF and MoREEFF, launched by the EBRD in 2010 for promoting energy efficiency projects and construction of renewable energy sources, as well as the EU-Moldova bilateral program. In 2011 the latter included a 42.6 million € package for the implementation of renewable energy sources and energy efficiency; the energy package launched by the World Bank is also worth mentioning.

Enabling business environment. Business environment in the Republic of Moldova is characterized by unjustified financial and time costs that essentially exceed the same in developed countries, not encouraging fair competition focused on productivity and innovation. Development of business environment is a priority in the National Development Strategy 2020.

Mechanisms for technology transfer. According to the IPCC report "Methodological and Technology Aspects of Technology Transfer", the technology transfer mechanisms include: the national innovation system, official development assistance (ODA), Global Environment Facility (GEF), multilateral development banks, Kyoto protocol mechanisms. The innovation system of the RM is still in the budding stage, and still lacks the essential elements of an innovation system. Total commitments of official development assistance for the Republic of Moldova amount to 4 524.4 million EUR, and already disbursed -2 461.55 million EUR as of 16.03.2017. From this amount, only a small part was channeled to GHG emissions mitigation. Since the RM acceded to GEF and applied for the GEF grants, the country has received a non-repayable financial support amounting to US$165.05 million, and US $446.59 million in the form of co-financing for 41 projects, including 11 projects related to climate change control. During the last operational phase in applying for GEF funds (GEF-6) for the period July 2014-June 2018, Moldova has received a project development and implementation proposal worth US$1.5 million in biodiversity protection, US$2.0 million in climate change control (US $3,219 million have already been spent) and about US$5.5 million to combat soil degradation (US$3.3 million have already been spent). Application for GEF-7 is underway. Among the multilateral development banks, the World Bank (WB) and the European Bank for reconstruction and development (EBRD) stood out in promoting sustainable development and environmental projects. Since 1992 until 2016, the World Bank has provided to the RM about US$1.4 billion for 97 projects. The current World Bank Group Strategy of partnership with Moldova includes financial commitments totaling to US$318 million for the fiscal years 2014-2017. Over the past 10 years the WB supported 16 projects with GHG mitigation impact, with a total financing worth US$215.8 million. The EBRD's assistance to the RM over the period 1991-January 2017 covered a total of 115 projects with a total value of €1 183 million, of which 640 million € as gross disbursements, and the share of private sector portfolio at 21%. Currently there are 45 EBRD projects in the pipeline with funding worth €485 million. Over the past 10 years 10 projects with direct impacts on mitigating GHG emissions in Moldova have been implemented, with a total funding of US$411.3 million.

Until now 11 CDM projects were submitted for approval to the Designated National Authority (DNA), of which 8 have been registered, are under way or have been already completed. Aiming at facilitating the MDN/CDM projects geared towards reducing the fossil fuels based production of electricity, the emission factor calculation tool to estimate the Grid Emissions Factor in the National Power System (GEFS) was developed in 2011, with the WB financial support, and all concrete values of the GEFS for the lending periods from 2010 to 2017, were determined.

ES.8. Financial, Technical and Capacity Needs Constraints

ES.8.1. Constraints in Mitigation of Direct GHG Emissions

ES.8.1.1. Energy Sector

Consumers' reduced payment capacity and relatively high cost of capital in the RM make the investments either difficult to be made, or unaffordable expensive. Most measures geared towards the direct GHG emissions reduction require investments that lead to increased prices for energy resources, which does not ensure the economy's sustainability. The lack of interest for the rehabilitation or construction of new power plants in an open electricity market is another major barrier. The availability of some electricity generation sources (Ukraine and CTEM) at lower prices, than the prices for electricity produced by a new plant, limit the investors' interest to build new sources of electricity in the country. The entry into force of the new Law on the promotion of the use of energy from renewable sources, is expected to booster the use of renewable electricity sources, provided the ceiling prices for this kind of energy will be known in advance.

ES.8.1.2. Transport Sector

One of the barriers related to enhancing energy efficiency of vehicles is the perceived commercial risk of investments in efficient technologies development, which partially stem from the lack of clear regulatory signals in the form of vehicle efficiency standards. The use of biofuel, taking into account the demand for arable land and water resources for irrigation, competes with more pressing objectives of internal policy related to ensuring food security.

ES.8.1.3. Buildings Sector

Many energy efficiency projects in the buildings sector are too small to attract the attention of investors and financial institutions. Thermal insulation of apartments in multi-storey blocks encounters difficulties of different types, either due to lack of economic interest because of connection to the district heating system, or due to the decrease in thermal load with negative impact on the performance of the existing CHPs.

ES.8.1.4. Industrial Sector

The existing machines and equipment in most of industrial enterprises have a high degree of moral and physical wear. The lack of enabling business environment is also a barrier to technology transfer.

ES.8.1.5. Agriculture Sector

Agriculture in Moldova is a volatile and very risks prone activity, particularly subjected to climatic factors (such as droughts, floods, frosts, hail, soil erosion). Reducing the dependence on such phenomena is a major challenge for the sector. Other barriers to the low-carbon development are related to insufficient financial coverage, excessive fragmentation of agricultural land, insufficient maintenance of conservative agriculture; lack of investments for recovery of the animal husbandry sector and for implementing sustainable manure management systems.

ES.8.1.6. Forestry Sector

The biggest problems identified in the forestry sector refer to the improper administration of forests, reduced bio-productive potential and guarding and insufficient guarding and protection of forests, lack of funding to ensure sustainable management, lack of the National Forest Inventory. With reference to the plant cultivation and soil resources, the sector strategies and programmes that have been approved so far have modestly contributed to the increase of organic matter in soil, which is the only way to reduce GHG emissions from agricultural lands.

ES.8.1.7. Waste Sector

Implementation of investment projects directed towards the establishment of an integral waste recycling and recovery system, as well as biological and mechanical treatment and storage thereof require the restructuring of the legal framework and institutional structures. The lack of solid waste processing capacity and lack of available land for solid waste deposits are other impediments on the way to overcoming the waste management problem.

ES.8.2. Capacity Building Needs in GHG Mitigation

Capacity building needs in GHG mitigation are relevant for and will be addressed in four dimensions:

a) to carry out studies, research and evaluations on climate change control;
b) to formulate sector climate strategies and policies;
c) to implement sector climate strategies and policies;
d) to facilitate participation in negotiation of future climate agreements at international level.

In major, the RM has some capacity to address the above-mentioned aspects, but it needs to be further developed, including with the assistance of international donors.

ES.8.3. Financial Needs in the Context of Ensuring Low-Carbon Development

In order to achieve the GHG emissions reduction objectives in the context of low emissions development two types of funding have to be available. The first concerns the need to achieve an adequate level of capacity in GHG emissions mitigation. The second refers to the amount of investment needed to implement measures and technologies that lead to the proposed GHG reductions.

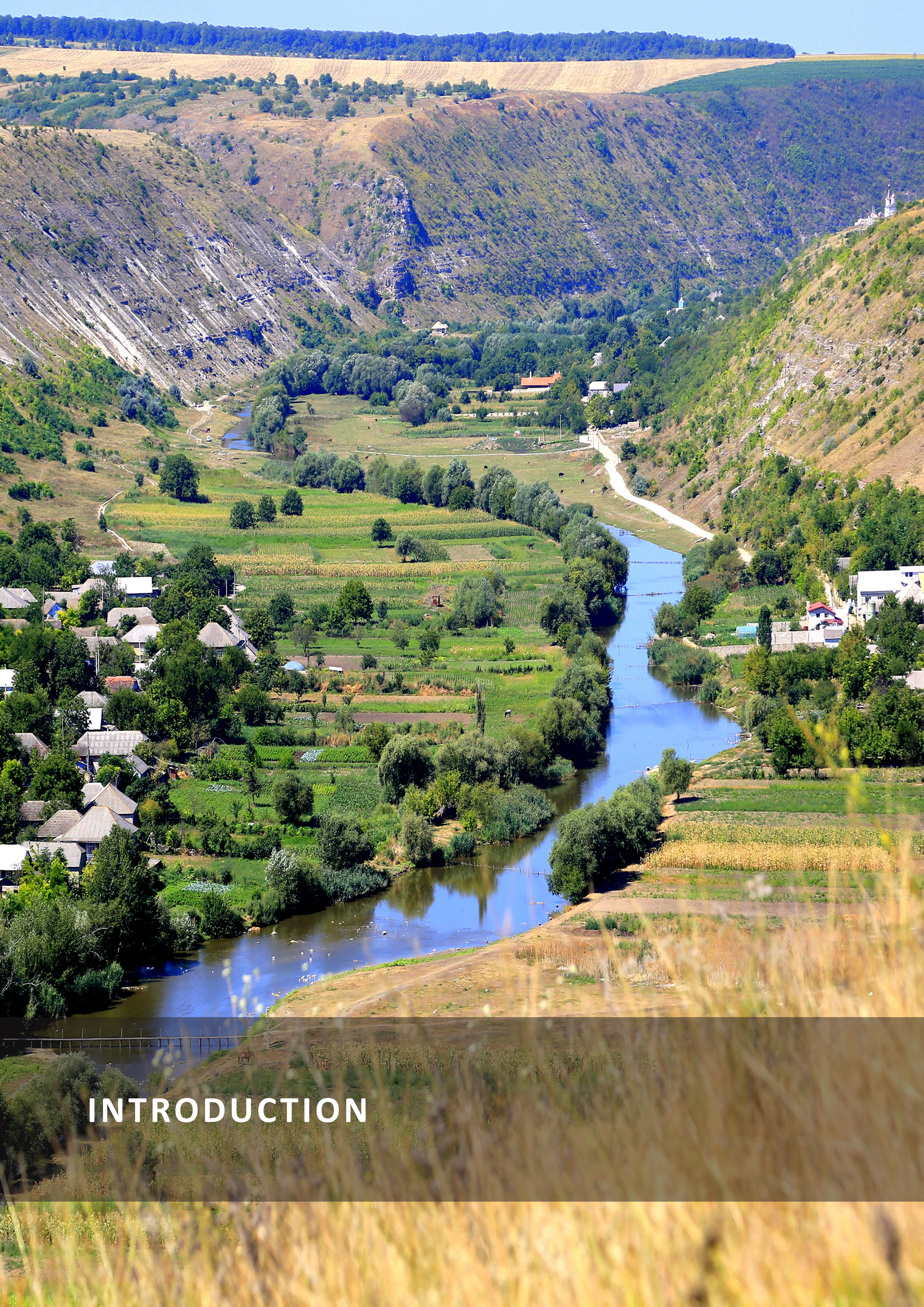
Estimates have shown that over the next five years about us US$1.2 million would be needed to build the capacity of the country to address climate change problems, of which circa US$0.3 million would be needed annually on a permanent basis, and the remaining amount as a one-time assistance payment, mainly provided by donors.

As regards the investments needed to implement measures and technologies leading to GHG emissions reduction, identified by the RM and which, at the same time, will ensure the sustainability of the national economy development, these were determined on the basis of investments planned to be harnessed for implementing Nationally Appropriate Mitigation Activities (NAMA) included in the Low Emission Development Strategy of the Republic of Moldova by the year 2030. The amount of investments needed in this respect is approximately US$8.6 billion.

ES.8.4. National LEDS and NAMA Implementation Arrangements

The Republic of Moldova intends to achieve GHG emissions reduction goals set out in the NDC by promoting the NAMA, which are identified and set out in the LEDS. The strategy document also provides for the Action Plan to NAMA implementation, which will be reviewed every five years.

Monitoring of the strategy implementation will be carried out by the Ministry of Agriculture, Regional Development and Environment. The national GHG emissions, as well as their evolution trends are regularly reported in the National Communications of the Republic of Moldova to the UNFCC, and in the national Inventory Reports. Annual monitoring reports will be developed through the monitoring process, and assessment and progress reports at every 5 years. In order to reduce costs and the time of the staff involved in monitoring, reporting and verification, the Nationally Appropriate Mitigation Actions will be monitored by using standard forms. The entire regulatory framework compliant with the UNFCC requirements on the development, approval, implementation, monitoring, reporting and verification of the nationally appropriate mitigation and adaptation activities will be drafted by the Ministry of Agriculture, Regional Development and Environment.



INTRODUCTION

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On March 16, 1995, the Republic of Moldova (RM) ratified the United Nations Framework Convention on Climate Change (UNFCCC), followed by the Kyoto Protocol, ratified on February 13, 2003, recognizing thus, the complex influence of climate change on humankind evolution.

As a developing country, Party to this Convention, the Republic of Moldova has committed to promote sustainable development, to contribute to the achievement of the Convention's ultimate objective and to assist Annex I Parties to fulfil their commitments to limit and reduce greenhouse gas emissions.

In this context should be considered the concerns related to such areas as: GHG inventories; identifying and implementing GHG emissions mitigation actions; identifying and implementing climate change adaptation actions; transfer of environmentally friendly technologies; improvement of the national system of observation and environment monitoring networks; improving information systems for collecting, processing and data storage; developing, maintaining and updating databases related to climate change; as well as various capacity building activities, education, training and public awareness raising actions within the civil society and youth regarding the climate change issue.

The Fourth National Communication of the RM to UNFCCC reflects the degree of compliance with the Convention provisions nominated nationwide, updated for 2015/2016 years, according to the statistical data available. This Report has been developed within the Project *„Republic of Moldova: Enabling Activities for the Preparation of the First Biennial Update Report and Fourth National Communication under the United Nations Framework Convention on Climate Change"*, initiated on July 7, 2014 and completed on December 31, 2017, implemented by the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment and the United Nations Environment Programme, with financial support provided by the Global Environment Facility. The Report outlines a series of actions in the areas indicated above, revealing directions for future work and establishing effective partnerships.

As a signatory Party of the Convention and a country that has ratified the Kyoto Protocol, the Republic of Moldova is concerned with analyzing opportunities arising from the fullest implementation of the flexible mechanisms available under the Kyoto Protocol, while actively taking part in post-Kyoto international negotiations, which are currently in progress.

Extensive information dissemination related to climate change phenomenon has contributed to a broader awareness rising within the society, scientific community and decision makers in the RM. Thus, one can say that the process of completing the First Biennial Update Report and the Fourth National Communication strengthened the country's potential, both for assessing climate change impact, as well as to promote and implement strategies, politics, action plans, programmes and technologies focused on mitigation the effects caused by such changes and adapt to new climate conditions.

It should also be noted the need for continuity in this direction, which would both make it possible for the RM to engage in global efforts to mitigate climate change, but would also involve the country's scientific and technical potential, qualified professionals in the adaptation process of national economic, social and environmental components to new climate conditions.

BUR1 and CN4 helped establish the mitigation targets included within the Nationally Determined Contribution (NDC), developed in accordance with Decisions 1/CP.19 and 1/CP.20, in the context of the Paris Agreement (2015) – an agreed outcome with legal force under the Convention, applicable to all Parties, in line with keeping global warming below 2°C.

The GHG reduction targets set out in the Nationally Determined Contribution of the Republic of Moldova were subsequently officially approved at national level by the Government Decision No. 1470 from 30.12.2016 regarding the approval of the Low Emissions Development Strategy of the Republic of Moldova by 2030 and the Action Plan for its implementation (Official Monitor No. 85-91 from 24.03.2017).

CHAPTER 1: NATIONAL CIRCUMSTANCES

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1.1. Physical Context

1.1.1. Geographical Location

The Republic of Moldova (RM), covering an area of 33,846 square km, is located in Central Europe, in the northwestern Balkans. The RM's capital city is the municipality of Chisinau (mentioned in the historical records for the first time in 1436) with a population of approximately 820.5 thousand people (NBS, 2017). The RM borders on Ukraine in the North, East and South and on Romania in the West, with the Western borderline going along the river Prut (Figure 1-1). The total length of the RM's national border is 1,389 km, including 939 km of the border with Ukraine and 450 km of the border with Romania.

The RM is situated at longitude 28˚50' east and latitude 47˚ north. The exact location of the extreme points on the RM's territory is as follows: the northernmost point is Naslavcea (latitude 48˚ 21' north and longitude 27˚ 35' east); the southernmost point is Giurgiulesti (latitude 45˚ 28' north and longitude 28˚ 12' east) which is also RM's sole location on the bank of the Danube; the westernmost point is Criva (latitude 48˚ 16' north and longitude 26˚ 30' east); the easternmost point is Palanca (latitude 46˚ 25' north and longitude 30˚ 05' east). The distance between the extreme points is about 350 km from Naslavcea to Giurgiulesti and only 120 km from the West to the East at the latitude of the municipality of Chisinau.

The RM is a Black Sea region country. Its southern border extends almost as far as the Black Sea coast, and the access to the Black Sea is open for RM through the Dniester estuary and the Danube.

1.1.2. Relief

The region between the Prut and the Dniester is a part of the Moldovan Plateau, which starts at the foothills of the Bukovina Mountain Crest and Moldova's Sub-Carpathians in the West and reaches as far as the Dniester in the East. The southwestern part of the Podol Upland extends along the left bank of the Dniester. Hills and flatland areas can be observed next to the upland relief within the framework of those major relief-forming units. The absolute altitudes are within the range of 429 m (Balanesti Hills) and 4 m above the sea level in the Dniester flood land (Palanca).

The relief has contributed to the formation and development of geographic landscapes and ecosystems - next to the other geo-ecological, biotic and socio-human factors. The current geo-ecological complex took shape at the end of the Late Pleistocene Epoch and in the first half of the Holocene (Recent) Epoch. The current biotic complex (flora, fauna, soil) and soils appeared in the second half of the Holocene epoch.

1.1.3. Climate

The climate of the Republic of Moldova is moderately continental, characterized by relatively mild winters with little snow, long warm summers and low humidity. The country is located in the area where the air masses coming from the Atlantic Ocean via Western Europe interact and mix with the air from the extreme continental northeastern regions and the Mediterranean air from the south-west. Two distinctive patterns can be observed regarding the territorial distribution

Figure 1-1: Map of the Republic of Moldova.

of the climatic features in RM: (i) distinct zoning of the annual rainfall averages which show a decreasing trend from the North to the South; and (ii) the increase by approximately 100 mm of the multiannual rainfall averages in the upland regions depending on the neighboring flatland areas.

The average annual air temperatures vary between 6.3°C (1980) in the North to 12.3°C (2007) in the South (Table 1-1). From 1990 to 2015, the absolute annual temperatures varied from a minimum of -28.0°C (January 2006) and a maximum of +39.5°C (July 2007). Warm weather lasts about 190 days.

Table 1-1: Average Annual Temperature, the Absolute Annual Maximum and Minimum at Briceni (North), Chisinau (Center) and Cahul (South) Stations in the RM within 1960–2015 periods

	Average Annual Temperature, °C			Absolute Annual Maximum Temperature, °C			Absolute Annual Minimum Temperature, °C		
	Briceni	Chisinau	Cahul	Briceni	Chisinau	Cahul	Briceni	Chisinau	Cahul
1960	8.4	10.6	11.2	33.0	34.6	34.3	-21.7	-17.8	-16.1
1970	7.9	10.1	10.3	30.5	32.0	31.5	-21.8	-19.1	-13.2
1975	9.0	10.8	11.0	31.0	33.0	34.0	-14.4	-9.2	-8.8
1980	6.3	8.3	8.5	31.1	30.9	32.0	-21.9	-14.0	-14.3
1985	6.5	8.0	8.2	36.2	33.9	34.7	-25.0	-18.7	-20.5
1986	7.9	9.6	9.7	34.3	34.3	33.5	-23.6	-19.4	-16.1
1987	6.5	8.1	8.5	34.6	34.3	36.2	-27.1	-22.8	-20.2
1988	7.5	9.0	9.3	35.1	36.1	36.0	-17.9	-16.4	-15.6
1989	9.3	10.9	10.9	32.6	34.1	33.0	-16.2	-14.3	-13.7
1990	9.5	11.3	11.4	33.2	34.7	34.5	-15.3	-14.8	-15.2
1991	8.0	9.4	9.3	30.1	31.9	30.6	-21.4	-18.7	-18.4
1992	8.5	10.1	10.2	35.6	34.9	35.7	-16.4	-11.9	-13.3
1993	7.8	9.4	9.3	33.4	35.3	34.6	-20.2	-15.5	-15.4
1994	9.5	11.3	11.3	34.7	34.9	33.6	-24.0	-20.9	-20.4
1995	8.4	10.0	10.0	33.2	33.4	33.6	-23.2	-16.9	-17.4
1996	7.1	9.1	9.1	32.6	35.4	35.9	-27.5	-21.1	-21.7
1997	7.7	9.4	9.1	30.9	32.4	32.8	-22.2	-18.6	-18.0
1998	8.2	10.3	10.1	34.5	36.0	36.5	-22.3	-17.6	-17.4
1999	9.2	11.0	10.9	33.1	36.1	34.4	-16.5	-14.5	-13.5
2000	9.7	11.2	11.2	36.8	38.5	39.2	-19.0	-15.6	-16.5
2001	8.8	10.3	10.4	33.6	36.6	35.9	-19.5	-15.7	-16.2
2002	9.5	10.8	11.0	34.5	37.2	35.5	-19.0	-16.5	-18.6
2003	8.6	9.8	10.3	33.7	35.7	36.4	-20.9	-17.4	-17.9
2004	9.0	10.3	10.9	32.4	33.0	35.3	-15.0	-13.1	-14.1
2005	8.7	10.5	10.8	34.3	35.6	35.5	-21.8	-15.5	-16.6
2006	8.4	10.2	10.8	31.1	33.6	36.2	-28.0	-24.2	-22.7
2007	10.1	12.1	12.3	36.6	39.5	39.4	-18.1	-16.0	-15.8
2008	9.7	11.3	11.8	34.0	37.5	37.9	-18.6	-15.3	-17.0
2009	9.6	11.4	11.8	33.5	36.3	37.9	-19.7	-16.8	-16.7
2010	8.9	10.6	11.2	35.3	36.6	36.8	-27.4	-21.8	-21.2
2011	9.1	10.5	10.6	33.3	33.6	34.8	-17.7	-16.0	-15.1
2012	9.3	11.2	11.7	37.4	39.2	39.3	-27.7	-22.2	-21.1
2013	9.4	11.1	11.5	32.6	33.3	34.1	-16.4	-12.9	-13.3
2014	9.3	10.9	11.3	33.7	36.5	35.2	-20.4	-20.9	-19.2
2015	10.5	12.0	12.1	36.4	37.0	36.5	-19.1	-16.8	-17.2

Annual precipitations are decreasing in intensity from North-West to Southeast. In 1960-2015 time series, the average annual precipitations varied between a minimum of 382 mm (2015) and a maximum of 960 mm (2010) in the North; respectively from a minimum of 307 mm (2003) and a maximum of 813 mm (1997) in the South (Table 1-2). The number of days with precipitations (0.1 mm and more) varied from a minimum of 111 (2014-2015) and a maximum of 174 days (1980 and 1987) in the North, respectively from a minimum of 91 (2003) and a maximum of 152 days (1991) in the South.

Table 1-2: Annual Amount of Precipitations and the Number of Days with Precipitations at Briceni (North), Chisinau (Center) and Cahul (South) Stations in the RM within1960–2015 periods

	Annual amount of precipitations, mm			Number of days with precipitations 0.1 mm and more		
	Briceni	Chisinau	Cahul	Briceni	Chisinau	Cahul
1960	661	537	435	140	118	102
1970	747	672	537	150	138	124
1975	535	483	519	130	105	102
1980	700	712	617	**174**	**151**	141
1985	672	593	564	143	124	120
1986	463	400	379	121	97	115
1987	619	593	525	**174**	134	137
1988	740	652	569	161	122	135
1989	653	460	441	137	98	109
1990	471	**360**	359	126	**96**	108
1991	655	673	661	161	125	**152**
1992	518	417	369	136	111	118
1993	557	533	537	145	112	111
1994	456	403	383	127	98	109
1995	609	702	401	152	120	121
1996	835	711	603	150	131	123
1997	587	607	**813**	139	120	123
1998	891	666	584	147	113	116
1999	564	484	674	132	116	126
2000	451	437	342	120	112	94
2001	711	618	600	155	110	107
2002	578	604	568	128	105	99
2003	618	459	**307**	137	112	**91**
2004	515	591	470	145	121	106
2005	800	638	513	137	132	110
2006	683	564	367	138	123	105
2007	618	480	517	131	114	95
2008	773	466	444	146	107	114
2009	445	446	405	132	122	101
2010	**960**	**734**	699	159	134	140
2011	439	428	371	120	**96**	93
2012	552	522	595	139	114	103
2013	639	531	716	141	112	110
2014	691	604	611	**111**	106	116
2015	**382**	431	466	**111**	102	107

1.2. Natural Resources

1.2.1. Land Resources

Republic of Moldova has unique land resources characterized by: predominant black soils (chernozems) with high productivity potential; very high utilization rate (>75 per cent); and rugged topography (above 80 per cent of the total arable land are located on hill slopes).

As of January 1, 2016, RM's total available land amounted to 3384.6 thousand hectares (NBS, 2016), including 2499.6 thousand ha (73.9 per cent) – of agricultural land; of which 1822.9 thousand ha (53.9 per cent) – arable land, 288.9 thousand ha (8.5 per cent) – perennial plantations; 347.1 thousand ha (10.3 per cent) – hayfields and pastures; 40.6 thousand ha (1.2 per cent) – fallow land; 465.2 thousand ha (13.7 per cent) – fallow land; 96.7 thousand ha (2.9 per cent) – rivers, lakes, water basins and ponds and 323.1 thousand ha (9.5 per cent) – other lands (Table 1-3).

Table 1-3: Available Land by Category in the Republic of Moldova within 1992-2016, thousand ha

	1992	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
Land – total, including:	**3376.0**	**3385.1**	**3384.4**	**3384.6**	**3384.4**	**3384.4**	**3384.6**	**3384.6**	**3384.6**	**3384.6**	**3384.6**
Agricultural land, of which:	2565.9	2556.7	2550.3	2521.6	2501.1	2498.3	2498.0	2497.8	2500.1	2499.7	2499.6
Arable land	1736.3	1758.7	1813.8	1840.2	1816.7	1812.7	1810.5	1814.1	1816.1	1817.4	1822.9
Perennial plantations, of which:	474.8	430.7	352.3	297.8	301.0	298.8	298.7	295.3	295.3	291.7	288.9
Orchards	224.5	208.3	170.8	131.9	132.5	133.3	134.5	135.1	135.8	134.5	132.5
Vineyards	215.8	202.6	168.9	155.5	153.5	149.6	147.3	142.6	141.2	137.5	132.5
Pastures	350.5	365.2	373.9	370.8	352.1	350.4	350.3	348.9	348.0	346.4	345.0
Hayfields	4.3	2.1	2.5	2.7	2.2	2.2	2.0	2.1	2.0	2.2	2.1
Fallow land	0.0	0.0	7.8	10.1	29.1	34.2	36.5	37.4	38.7	42.0	40.6
Forest land and areas covered with woody vegetation	421.7	425.3	422.7	439.5	462.8	463.1	462.7	464.2	465.2	464.5	465.2
Rivers, lakes, water basins and ponds	88.7	92.6	95.5	96.8	96.4	99.6	99.5	99.2	96.9	96.8	96.7
Other lands	299.7	310.5	315.9	326.7	324.3	323.6	324.4	323.4	322.4	323.6	323.1

Source: Statistical Yearbooks of the RM for 2016, 2014, 2012, 2008, 2003, 1999 and 1994.

According to the General Land Cadaster of the Republic of Moldova, in 2016, the use of agricultural land by various landowners was as it follows: 74 state agribusiness enterprises with a total area of 179.1 thousand ha (8.8 per cent); 75 scientific research and education institutions with a total area of 20.9 thousand ha (1.0 per cent); 132 of other enterprises and auxiliary households in state ownership - 72.4 thousand ha (3.6 per cent); 34.8 thousand lands in the public property of the administrative-territorial units with a total area of 55.2 thousand ha (2.7 per cent); 2,058 production cooperatives with a total area of 90.5 thousand ha (4.5 per cent); 152 joint stock companies with a total area of 32.1 thousand ha (1.6 per cent); 33.7 thousand limited liability companies - 745.5 thousand ha (36.8 per cent); 366.4 thousand peasant farms - 526.8 thousand ha (26.0 per cent); 788.3 thousand lands used individually by private owners with a total area of 230.3 thousand ha (11.4 per cent); 35.5 thousand of orchard farms - 2.6 thousand ha (0.1 per cent) and 96.9 thousand of other lands with a total area of 72.0 thousand ha (3.5 per cent).

RM's soil cover is very diverse and comprised of above 745 soil types. Chernozems (black soils) accounts for approximately 73.7 per cent of the country's total territory; grey forest soil (found mainly on elevations with altitudes above 200 m on the Northern Plateau, on hills along the Dniester and in the Codrii Zone) accounts for about 9.4 per cent, and brown forest soil (found on hilltops at altitudes exceeding 300 m, covered currently or previously with beech, hornbeam and oak tree forests) - respectively for about 0.6 per cent; alluvial soils (found in river floodplains and water meadows on recent alluvial deposits) account for approximately 10.2 per cent; and deluvial soils (formed on hill slopes and in valleys from soil particles brought by the land erosion processes) - respectively about 3.7 per cent; rendzine (soddy-calcareous) soils (formed on limestone under the influence of the steppe and forest grass aggregations) – about 1.0 per cent; chernozem-like, swamp and humus-peaty soils (found in fragments in forest-steppe zones) – about 0.7 per cent; vertisol soils (formed predominantly in the steppe and forest-steppe environment, under grass canopy on the bed of hard clay rock) – about 0.4 per cent; and alkaline (solonetzic) and saline soils account for about 0.2 per cent of the Republic of Moldova's total territory. The extremely high land utilization rate in agriculture dictates the necessity of rational use, resource conservation, amelioration and protection of soils from erosion, landslides and other types of ill-considered human intervention.

1.2.2. Water Resources

Rivers. There are 3621 rivers and water-springs in the Republic of Moldova. All of them form part of the Black Sea basin and can be categorized as follows: the Dniester Basin Rivers, the Prut Basin Rivers and the southern region rivers falling either into the Danube estuary or in the Black Sea coastal salt lakes. The majority of rivers are small. The largest rivers include the Dniester (1,352 km long, including 657 km in the RM, with the annual water debit of approximately 2.4 km^3), Raut (286 km), Cogalnic (243 km, including 125 km in the RM), Bac (155 km), Botna (152 km). The RM's drainage network densities 0.48 km per square kilometer on the average, varying between 0.84 km/km^2 in the northern regions and 0.12 km/km^2 in the regions on the left bank of the Dniester. The main water sources feeding the rivers are snowfalls and rainfalls, whereas the groundwater plays only a minor role. The majority of precipitations occur in the form of rainfall, whereas snow accounts for as little as 10 per cent of the total precipitations. High water levels are observed in spring due to the melting snow (40-50 per cent of the annual flow). In summer the water levels in rivers - and in particular in small rivers – can rise considerably after storm rainfall, sometimes causing disastrous floods.

Lakes. There are approximately 60 natural lakes in the Republic of Moldova. Most of them are lakes located in the high-water beds of the rivers Prut (Beleu, Rotunda, Fontan) and Dniester (Old Dniester, Cuciurgan). In addition, there are above 3,500 water storage ponds created and maintained for diverse economic purposes (such as irrigation, fishing, recreation, industrial and household needs, protection from floods). Large water-storage reservoirs have been created for hydropower plants: Costesti–Stinca (735.0 mill. m^3) on the river Prut jointly with Romania; and Dubasari (277.4 mill. m^3) on the Dniester river.

Groundwater. Groundwater has a special role in the surface water balance in the RM. They participate actively in the hydrological cycle as a component of the ground water debit. The distribution of the available ground waters is not even across the country, because their major portion is concentrated in the high-water beds of the Dniester and the Prut. The water supply capacity of the ground water-bearing horizons decreases with the increasing distance to those rivers.

The country has 17 horizons and water systems of various ages and uneven distribution[3]. Six of these water horizons are more

[3] <http://moldova-suverana.md/article/apa-este-dimensiunea-ecologic-fundamental-a-existenei_423>.

important: the alluvial horizon dating back to the Quaternary Epoch (22 mil m^3), the Middle Sarmatian horizon (110 mil. m^3), the Early Sarmatian and the Badenian water system (770 mil. m^3), the Cretaceous (110 mil. m^3), the Late Sarmatian and the Pontian horizon (44 mil m^3). In most water horizons, circa 50 per cent presents potable properties, except for the phreatic horizon – 20-30 per cent. Groundwater reserves are around 1,100 mil m^3, while those approved for economic needs represent circa 255000 m^3 per day. About 6,200 artesian wells and circa 250 thousand fountains fed from groundwater wells supply circa 40 per cent of rural population, which provides 1811 thousand m^3/day confirmed groundwater reserves. Of the total national groundwater resources, only 50 per cent can be used for drinking purposes without prior treatment.

Mineral Waters. Currently, in the RM, about 50 types of mineral waters in circa 170 mineral water springs are approved for use and certified, but about half of them (particularly, because fluoride and hydrogen sulphide content exceeds by 10 and respectively 8 times the maximum permitted), are not operating[4]. Of these, circa 25 mineral water springs (Varnita–III, Branesti, Purcari, Edinet-II, Micauti, Cotiujeni, Orhei, Balti-III, Ialoveni, etc.), including therapeutic mineral water springs (Source no. 3 from Gura Cainarului village) are new springs, appreciated because of the last years prospections. Water mineralization levels vary between 1 and 10 g/dm^3. Mineral water springs are typical for the southern and northeastern regions of the country, containing hydrocarbonates and hydrocarbonates-sulfates prevailing the sodium and calcium cations. Their water contains hydrogen sulphide (30-80 mg/dm^3), iodine (17-26 mg/dm^3), bromine (132-139 mg/dm^3) and other chemical elements (lithium, radon, strontium, boron).

Industrial Waters. The industrial ground water available in the RM contains less-common extractable chemical elements, with the waters containing iodine, bromine, strontium, cesium, rubidium, boron and helium being the most widespread. The highest concentration of chemical elements in the water with mineralization levels of 70-100 g/dm^3 is 60 mg/dm^3 for iodine; 360 mg/dm^3 for bromine; 380 mg/dm^3 for strontium; 1.0 mg/dm^3 for cesium; 3 mg/dm^3 for rubidium; and 15.0 ml/dm^3 for helium.

Thermal Waters. Thermal water is common in the high-water bed of the Prut and in the southern regions of the RM. The water temperature is 20-80°C, and the water debit of the wells is 10-100 m^3 per day.

1.2.3. Biological Resources

Flora. The RM's geographic location, climate and relief have pre-conditioned the development of extremely various vegetation with a large number of species; currently the country's flora comprises about 5,638 species: superior plants – 2,014 species (vascular plants – 1,856 species (pteridophytes – 25 species, gymnosperms – 1 specie, angiosperms – 1830 species), respectively bryophytes (mosses) – 158 species); inferior plants – 3,624 species (lichens – 124 species and algae – 3,500 species). The ecosystems which have the richest flora composition include: the forest (above 850 species), steppe (above 600 species), high-water basin (about 650 species), petrophyte (circa 250 species), water and swamp (about 160 species) systems. In the Republic of Moldova, there are also 1200 species of fungi and 836 species of macromycetes.

In terms of landscape, the RM's territory is located in two natural zones – wooded steppe and steppe. The steppe zone comprises the fields and elevations in the regions to the south of the Codrii Upland and to the south and east of the Tigheci Hills. In addition to the above, the steppe flora can be found also in the North - in the Cubolta Upland, in the Ciulucuri Hills and in the Middle Prut Upland.

Most of the steppe regions are used currently in agriculture; and therefore the typical steppe flora represented by mat-grass, feather grass, fescue and diverse other grass types has persisted solely on small hill slope areas with old landslides or on more inclined erodible slopes. Of the total number of steppe plant species, 18 have been included in the Red Book of Moldova, including 9 species (*Astragalus dasyanthus Pall., Belevallia sarmatica (Georgi) Woronow, Bulbocodium versicolor (Ker.-Gawl.) Spreng., Colchicum triphyllum G.Kunze, C. Fominii Bordz., Galanthus elwesii Hook. fil., Ornithogalum amphibolum Zahar., O. oreoides Zahar., Stembergia colchiciflora Waldst. et Kit.*), which are also included in the Red Book of Ukraine (1996) and in Romania's Red List of superior plants (1994).

The forest flora can be found - in addition to the steppe regions - in the wooded steppe zone, on higher hills more frequent in the Codrii Region. The deciduous forests typical of the Central Europe prevail and account for 97.9 per cent (including Quercus spp. – 39.6 per cent, Robinia spp. – 36.1 per cent, Fraxinus spp. – 4.6 per cent, Carpinus spp. – 2.6 per cent, Populus spp. – 1.6 per cent), whereas resinaceous forests account for as little as 2.1 per cent.

The country's forest ecosystems include 45 native species of trees, 81 native species of shrubs and 3 native species of forest vines (lianas). The most common native woody plant species found in our forests include: English Oak *(Quercus robur)*, Durmast Oak *(Quercus petraea)*, Pubescent Oak *(Quercus pubescens)*, Common Ash *(Fraxinus excelsior)*, European Hornbeam *(Carpinus betulus)*, European White Elm *(Ulmus laevis)*, Sycamore Maple *(Acer pseudoplatanus)*, Small-Leaved Linden *(Tilia cordata)*, European Weeping Birch *(Betula pendula)* and European Beech *(Fagus sylvatica)*.

Fauna. The RM's fauna is relatively rich and manifold. There are above 15.0 thousand species of animals in Moldova, including 461 species of vertebrates and above 14 thousand species of non-vertebrates. The vertebrates include 70 species of mammals, 281 bird species, 14 reptile species, 14 amphibian species and 82 fish species. Birds are highest in number among the vertebrates (281 species and subspecies), and insects - among non-vertebrates (above 12 thousand species).

The most widespread native species of mammals include: brown long-eared bat *(Plecotus auritus)*, hedgehog *(Erinaceus europaeus)*, European mole *(Talpa europaea)*, common shrew *(Sorex araneus)*, noctule bat *(Nyctalus noctula)*, red squirrel *(Sciurus vulgaris)*, brown hare *(Lepus europaeus)*, European ground squirrel *(Citellus citellus)*, spotted squirrel *(Citellus suslicus)*, house mouse *(Mus musculus)*, Norway rat *(Rattus*

[4] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352740>.

norvegicus), wood mouse *(Apodemus sylvaticus)*, yellow-necked mouth *(Apodemus flavicollis)*, red fox *(Vulpes vulpes)*, European roe deer *(Capreolus capreolus)*, wild boar *(Sus scrofa)*, Eurasian badger *(Meles meles)*, beech marten *(Martes foina)*, European polecat *(Mustela putorius)*, and least weasel *(Mustela nivalis)*. Rare and endangered species are protected by the law; 116 animal species have been entered in the Red Book of Moldova (the edition of 2001), including 14 mammal species, 39 bird species, 8 reptile species, 1 amphibian species, 12 fish species, 1 Cyclostomata species, 37 insect species, 1 Crustacean species and 3 Mollusc species.

The mammals populate mostly the forest ecosystems – 47 species, meadows – 33 species and agricultural ecosystems – 25 species, while the birds populate mostly the water ecosystems – 109 species, the forest – 106 species, agricultural ecosystems – 76 species, steppe – 45 species and petrophyte ecosystems – 23 species.

There are five natural reservation established for scientific research purposes with the total area of 19.4 thousand ha in the Republic of Moldova. Two natural forest reservations – "Codrii" and "Plaiul Fagului" – are located in the central regions of Moldova; two more reservations – "Prutul de Jos" and "Padurea Domneasca" – in the Prut valley; and the fifth reservation – "Iagorlic" (Dubasari district) – has been established to protect and study the unique water ecosystem of the Dniester river.

1.2.4. Mineral Resources

The most popular minerals used in the Republic of Moldova are: (1) carbonate strata rocks dating back to the Early Sarmatian and Badenian Epoch - used in construction of industrial facilities and housing, cement production, sugar refining, road construction, as additives to animal feed, etc.; (2) clint rocks (siliceous limestone, diatomite/kieselgur, fossil meal/tripoli) - used in food industry, production of artificial leather, paper, thermal and electro-thermal materials, etc.; (3) clay rocks (slate clay, bentonite clay, ordinary clay) - used in production of cement, ceramite, bricks, tiles and ceramic pipes; (4) sand and broken stone (gravel) - used in the manufacture of glass, concrete, in the various construction sectors including road construction; (5) sulphate rocks (gypsum) - used in construction, medicine, pharmaceutics; (6) crystal rocks (gabbro, granite, gabbro-norite) - used in production of ferro concrete, in road construction; (7) caustobioliths (oil, gas, brown coal) available in insignificant quantities in the South (Valeni, Victorovca, Vladiceni).

Mineral resources in the Republic of Moldova are extracted from 415 deposits, of which only one third operate. The country holds industrial reserves of about 400 million tons of gypsum, sand for glass production, tripoli, diatomite and 1500 million m^3 of stone, gravel, limestone, clay, while non-metallic minerals are extracted from 900 local quarries Also, 37 deposits are being prepared for use, 230 represent exploitable reserves while 21 are not intended for exploitation.

The most common used minerals are carbonate, siliceous and clay rocks, as well as gravel and sand, sandstones, gypsum, granite and gabbro. The limestone and clay are the most used mineral resources in the construction industry.

In 2015, the volume of calcareous stones extraction used for carving or construction represented 279.4 kt, while the volume of other types of rocks used with a similar purpose – about 6,384 kt. Gypsum, another widely used mineral reached, in 2013, an extracted volume of 369.2 kt.

Other minerals, widely used in the Republic of Moldova, are granite, sand and gravel-sand used for mortar and concrete production in construction. In 2015, it was recorded a total extraction volume of: sand – 1,599.9 kt; broken stone (gravel), boulders and flint – circa 2,717.1 kt, while sand and gravel mix, respectively, - circa 1,087.8 kt. Most of the minerals are extracted from open mines, and only certain limestone varieties are mined from stone quarries (underground galleries).

Modest reserves of hydrocarbons have been identified in the Southern regions of the country, such as oil (Valeni, Cahul district), natural gas (Victorovca, Cantemir district) and brown coal (Etulia, UTA Gagauzia). According to official estimates, oil reserves represent circa 2.1 million tons while natural gas – about 960 million m^3. As a result, in 2015, circa 7 kt of oil was extracted from Valeni oil fields and about 89 thousand cubic meters of natural gas were extracted from Victorovca gas fields.

1.3. Administrative-Territorial Organization, Population and Human Development

1.3.1. Administrative-Territorial Organization

According to the Law No. 764 as of 27.12.2001 on the administrative territorial organization, the Republic of Moldova is divided into 32 districts (rayons), 5 municipalities and 2 administrative-territorial units (Figure 1-2).

In most districts (Anenii Noi, Basarabeasca, Briceni, Cahul, Cantemir, Calarasi, Causeni, Cimislia, Criuleni, Donduseni, Drochia, Edinet, Falesti, Floresti, Glodeni, Hincesti, Ialoveni, Leova, Nisporeni, Ocnita, Orhei, Rezina, Riscani, Singerei, Soroca, Straseni, Soldanesti, Stefan Voda, Taraclia, Telenesti, Ungheni) the administrative center is located in a town, and only the district of Dubasari has the Cocieri commune as its center. By January 1, 2017, the number of population in the districts varied between a minimum of 28.2 thousand people (Basarabeasca district) to a maximum of 124.8 thousand people (Orhei district).

In the Republic of Moldova municipalities are urbanized areas, which play a significant role in the nation's economic, social-cultural, scientific, political and administrative life, with relevant industrial, commercial, health care and cultural facilities as well as educational establishments. In most cases, municipalities are an agglomeration of several settlements. For example, the municipality of Chisinau, which is the capital city of the Republic of Moldova, comprises 35 settlements, which include 5 city districts, 6 towns and 12 communes (the latter comprising the total of 26 settlements). The other 4 municipalities are: Balti, Comrat, Tiraspol and Bender (Tighina).

The purpose of dividing the territory of the country into a number of administrative territorial units is to ensure the

Figure 1-2: Administrative-Territorial Map of the Republic of Moldova.

execution of the principles of local autonomy, decentralize public services, electiveness of the local public administration authorities, and the access for the citizens to the elected authorities and to the advice on the local problems and issues of particular interest. All local problems and issues fall within the authority and powers of the local administrative councils, which are elected. The prefects and mayors for the districts and municipalities are nominated by the local administrative councils and appointed by the President of the Republic of Moldova.

There are two administrative-territorial units in the Republic of Moldova: the Administrative-Territorial Unit Gagauzia (ATU Gagauzia) and the administrative-territorial units on the left bank of the Dniester (ATULBD). The area of ATU Gagauzia is approximately 3000 km^2 (162.0 thousand people)[5], while the area of ATULBD is respectively about 4163 km^2 (475.7 thousand people)[6].

[5] <http://statbank.statistica.md/pxweb/pxweb/ro/20%20Populatia%20si%20procesele%20demografice/20%20Populatia%20si%20procesele%20demografice__POP010/POP010300reg.px/?rxid=2345d98a-890b-4459-bb1f-9b565f99b3b9>

[6] <http://mer.gospmr.org/gosudarstvennaya-sluzhba-statistiki/informacziya/ezhegodnik-gosudarstvennoj-sluzhby-statistiki.html>.

Since the collapse of the Soviet Union (USSR), the administrative-territorial units on the left bank of the Dniester started promoting the separatist policy in respect of the RM's centralized public administration authorities. Currently, the official authorities of the Republic of Moldova monitor that area only partially.

1.3.2. Population

As of 01.01.2016, the population of the RM was 4030.3 thousand people, with the density of approximately 119.1 persons per square kilometer. Thus, numerically the Republic of Moldova outruns such European countries as Lithuania, Ireland or Slovenia.

During 1990-2015, the population decreased by about 7.6 per cent or by 331.3 thousand people. That decrease was caused by the negative natural balance as well as the negative external migration flow balance. The above dynamics resulted in the decrease in the average population density from 129.2 persons per square kilometer in 1990 down to 119.1 persons per square kilometer at the end of 2015. However, even in such conditions the density of population in the Republic of Moldova significantly exceeds the average population density in Europe and the world average.

Females prevail with 52.2 per cent in the nation's population, as opposed to 47.8 per cent of males in the total population. This clear misbalance with prevalence of females in the population structure by gender has rated the Republic of Moldova among the top 10 states worldwide according to that indicator, thus impacting adversely the nation's demographic development. The majority of the population is concentrated in the rural areas. The existing 1614 rural settlements have 2,190.4 thousand residents or 54.3 per cent of the total population, averaging about 1400 residents per settlement. The urban population is 1,839.9 thousand residents or 45.7 per cent. The urbanization rate is among the lowest in Europe. Urban settlements are small in size, with about 27 thousand residents on the average, and only 8 thereof can boast the population exceeding 33 thousand residents: Chisinau (820.5 thousand people), Balti (151.2 thousand people), Tiraspol (128.2 thousand people), Bender (Tighina) (83.8 thousand people), Ribnita (44.8 thousand people), Cahul (39.5 thousand people), Ungheni (38.3 thousand people), Soroca (37.6 thousand people) and Orhei (33.9 thousand people).

According to the data of the 2014 population census held separately in the areas on the right bank of the Dniester and in the administrative-territorial units on the left bank of the

Table 1-4: Resident Population by the Main Nationalities in the Republic of Moldova (according to the 2004 and 2014 population census data)

	Population		in % compared to total population		in % compared to total population who declared the ethnicity	
	2004	2014	2004	2014	2004	2014
Total population on the Right Bank of Dniester River	**3 383 332**	**2 804 801**	**100.0**	**100.0**	**x**	**x**
Population who declared ethnicity, *including:*	**3 369 312**	**2 754 719**	**99.6**	**98.2**	**100.0**	**100.0**
Moldovans	2 564 849	2 068 058	75.8	73.7	76.1	75.1
Ukrainians	282 406	181 035	8.3	6.5	8.4	6.6
Russians	201 218	111 726	5.9	4.0	6.0	4.1
Gagauz	147 500	126 010	4.4	4.5	4.4	4.6
Romanians	73 276	192 800	2.2	6.9	2.2	7.0
Bulgarians	65 662	51 867	1.9	1.8	1.9	1.9
Gypsies	12 271	9 323	0.4	0.3	0.4	0.3
Other	22 130	13 900	0.7	0.5	0.7	0.5
Population who refused to declare ethnicity	14 020	50 082	0.4	1.8	x	x
Total population on the Left Bank of Dniester River	**555 347**	**475 665**	**100.0**	**100.0**	**x**	**x**
Population who declared ethnicity, *including:*	**538 148**	**409 548**	**96.9**	**86.1**	**100.0**	**100.0**
Moldovans	177 382	135 565	31.9	28.5	33.0	33.1
Ukrainians	160 069	108 927	28.8	22.9	29.7	26.6
Russians	168 678	138 419	30.4	29.1	31.3	33.8
Bulgarians	13 858	11 416	2.5	2.4	2.6	2.8
Gagauz	4 096	5 232	0.7	1.1	0.8	1.3
Byelorussians	3 811	2 378	0.7	0.5	0.7	0.6
Germans	2 071		0.4	0.0	0.4	0.0
Jews	1 259		0.2	0.0	0.2	0.0
Transdniesters		952	0.0	0.2	0.0	0.2
Other	6 924	6 659	1.2	1.4	1.3	1.6
Population who refused to declare ethnicity	17 199	66 117	3.1	13.9	x	x
Total population in the Republic of Moldova	**3 938 679**	**3 280 466**	**100.0**	**100.0**	**x**	**x**
Population who declared ethnicity, *including:*	**3 907 460**	**3 164 267**	**99.2**	**96.5**	**100.0**	**100.0**
Moldovans	2 742 231	2 203 623	69.6	67.2	70.2	69.6
Ukrainians	442 475	289 962	11.2	8.8	11.3	9.2
Russians	369 896	250 145	9.4	7.6	9.5	7.9
Gagauz	151 596	131 242	3.8	4.0	3.9	4.1
Romanians	73 276	192 800	1.9	5.9	1.9	6.1
Bulgarians	79 520	63 283	2.0	1.9	2.0	2.0
Gypsies	12 271	9 323	0.3	0.3	0.3	0.3
Other	32 384	21 511	0.8	0.7	0.8	0.7
Population who refused to declare ethnicity	31 219	116 199	0.8	3.5	x	x

Dniester, Moldavians / Romanians accounted for about 73.1 per cent of the country's population (64.5 per cent in 1989), Ukrainians – 8.8 per cent (13.8 per cent in 1989), Russians – 7.6 per cent (13.0 per cent in 1989), Gagauz – 4.0 per cent (3.5 per cent in 1989), Bulgarians – 1.9 per cent (2.2 per cent in 1989), Gypsies – 0.3 per cent (0.3 per cent in 1989), other nationalities – 0.7 per cent (1.3 per cent in 1989) (Table 1-4).

1.3.3. Demographic Situation

Within 1990-2016 periods, the demographic processes registered a distinctive negative development pattern (Table 1-5), which showed itself in the general instability of demographic indicators and phenomena as well as falling birth rate, growing mortality, depopulation, demographic ageing etc.

Table 1-5: The Dynamic of Demographic Indicators on the Right Bank of Dniester within 1990-2016

	Live Births	Deceased	Infant Mortality	Natural Balance	Marriages	Divorces
1990	77085	42427	1482	34658	40809	13135
1991	72020	45849	1441	26171	39609	13879
1992	69654	44522	1294	25132	39340	14821
1993	66179	46637	1437	19542	39469	14468
1994	62085	51514	1422	10571	33742	13811
1995	56411	52969	1214	3442	32775	14617
1996	51865	49748	1065	2117	26089	13440
1997	45583	42957	901	2626	22106	10153
1998	41332	39922	738	1410	21814	10156
1999	38501	41315	714	-2814	23524	8913
2000	36939	41224	681	-4285	21684	9707
2001	36448	40075	597	-3627	21065	10808
2002	35705	41852	528	-6147	21865	12698
2003	36471	43079	522	-6608	24961	14672
2004	38272	41668	464	-3396	25164	14918
2005	37695	44689	468	-6994	27187	14521
2006	37587	43137	442	-5550	27128	12594
2007	37973	43050	428	-5077	29213	13923
2008	39018	41948	473	-2930	26666	12601
2009	40803	42139	493	-1336	26781	11884
2010	40474	43631	476	-3157	26483	11504
2011	39182	39249	431	-67	25900	11120
2012	39435	39560	387	-125	24262	10637
2013	37871	38060	359	-189	24449	10775
2014	38616	39494	372	-878	25624	11130
2015	38610	39906	375	-1296	24709	11199
2016	37394	38489	353	-1095	21992	10605

Source: <http://statbank.statistica.md/pxweb/Database/RO/02%20POP/POP02/POP02.asp>

For example, the 2016 birth rate – 10.5‰ (a significant decrease in comparison with the 1990 rate of 17.7‰) was slightly lower the mortality rate – 10.8‰ (increasing compared to 1990 – 9.7‰). The infant mortality rate remained among the highest in Europe (9.4 ‰) but was lower than the 1990 figures (19.0‰). Between 1999 and 2010, the natural balance of the population was profoundly negative, while within 2011-2016 periods, it varied insignificantly around 0.0‰ (2011-2012) and -0.3‰ (2015-2016) (in 1990 the natural population growth represented 8.0‰).

That dynamics has resulted, among other things, in the demographic ageing of the population, which shows itself as the reduced portion of the young and the increased portion of the elderly. During 1990-2016, the share of population aged under 15 decreased from 27.9 per cent in 1990 to 17.0 per cent in 2016, and the age group of persons above 57/62 years increased, respectively, from 12.6 per cent in 1990 up to 18.5 per cent in 2016 (Table 1-6).

During 1990-2016, the 'average life expectancy at birth' indicator somewhat increased - from 68.0 years in 1990, to 72.2 years in 2016 (the respective indicator increased from 63.9 years to 68.1 years for males and from 71.9 years to 76.2 years for females) (Table 1-7).

The values of this particular indicator are relatively modest - as opposed to other countries, thus rating the RM among the last in Europe on the force of those levels.

1.3.4. Public Health

It is believed that the state of public health is determined by four major groups of factors: life style (accounting for 50-55 per cent), the environmental situation (20-25 per cent), genetics (15-20 per cent) and the effectiveness of the health care and preventive health care facilities (8-10 per cent). The nature of the environmental factors affecting public health may be chemical, physical, biological, psychological, genetic, cultural, or behavioral.

The current environmental situation in the RM cannot be characterized as the one contributing to healthy and long life. The main problems are caused by the negative impact of polluted air, water, soil and food on human health. The neglect of the public health problems - in particular in the rural areas, which are caused by the environmental factors, threatens with severe consequences for the public as well as for the national economy. During 2005-2016, the overall mortality rates tended to increase (Table 1-8).

Table 1-6: The RM's Population by Age, Area and Sex, at the end of 2016, on the Right Bank of Dniester

	Total			Urban			Rural		
	Total by Sex	Males	Females	Total by Sex	Males	Females	Total by Sex	Males	Females
Total, thousand people	**3 550.9**	**1 707.4**	**1 843.5**	**1 516.8**	**711.2**	**805.6**	**2 034.0**	**996.2**	**1 037.9**
Under the working age (0-15 years)	604.1	311.3	292.8	220.4	114.5	105.9	383.7	196.8	186.9
Working age (16-56/61 years)	2 291.4	1 191.7	1 099.7	1 012.7	509.7	503.0	1 278.7	682.0	596.7
Above the working age (57/62 years)	655.3	204.3	451.0	283.7	87.0	196.8	371.6	117.4	254.2
Total, %	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Under the working age (0-15 years)	17.0	18.2	15.9	14.5	16.1	13.1	18.9	19.8	18.0
Working age (16-56/61 years)	64.5	69.8	59.7	66.8	71.7	62.4	62.9	68.5	57.5
Above the working age (57/62 years)	18.5	12.0	24.5	18.7	12.2	24.4	18.3	11.8	24.5

Source: <http://statbank.statistica.md/pxweb/pxweb/ro/20%20Populatia%20si%20procesele%20demografice/20%20Populatia%20si%20procesele%20demografice__POP010/POP010600.px/?rxid=2345d98a-890b-4459-bb1f-9b565f99b3b9>

Table 1-7: Average Life Expectancy at Birth by Area on the Right Bank of Dniester 1990-2016, years

	Total			Urban			Rural		
	Total by Sex	Males	Females	Total by Sex	Males	Females	Total by Sex	Males	Females
1990	68.0	63.9	71.9	70.2	66.6	73.5	66.9	63.4	70.3
1991	67.7	64.3	71.0	69.6	66.1	72.8	66.2	62.5	69.7
1992	68.0	63.9	71.9	69.7	65.4	73.8	66.6	62.3	70.6
1993	67.5	63.9	70.9	69.7	65.4	73.8	66.6	62.3	70.6
1994	66.1	62.3	69.8	67.5	63.4	71.5	64.9	61.1	68.5
1995	65.8	61.8	69.7	67.3	63.3	71.3	64.6	60.7	68.5
1996	66.7	62.9	70.4	67.3	63.3	71.3	64.6	60.7	68.5
1997	66.6	62.9	70.3	67.6	63.6	71.6	65.9	62.2	69.6
1998	67.8	64.0	71.4	68.4	64.5	72.3	67.3	63.5	70.9
1999	67.4	63.7	71.0	68.4	64.6	72.2	66.8	63.1	70.3
2000	67.6	63.9	71.2	68.8	65.0	72.6	66.8	63.1	70.4
2001	68.2	64.5	71.8	69.6	65.7	73.6	67.3	63.6	70.9
2002	68.1	64.4	71.7	69.7	65.9	73.7	67.1	63.4	70.7
2003	68.1	64.5	71.6	69.8	66.3	73.4	67.1	63.3	70.8
2004	68.4	64.5	72.2	70.4	66.6	74.2	67.4	63.4	71.4
2005	67.9	63.8	71.7	70.0	66.1	74.0	66.5	62.4	70.6
2006	68.4	64.6	72.2	70.4	66.5	74.1	67.2	63.3	71.1
2007	68.8	65.0	72.6	70.5	66.4	74.3	67.8	64.2	71.5
2008	69.4	65.6	73.2	71.2	67.1	75.1	68.2	64.6	72.0
2009	69.3	65.3	73.4	71.5	67.5	75.3	68.0	64.0	72.2
2010	69.1	65.0	73.4	72.0	67.8	76.3	67.4	63.4	71.7
2011	70.9	66.8	74.9	73.2	69.1	77.2	69.5	65.5	73.6
2012	71.1	67.2	75.0	73.5	69.3	78.0	69.6	65.8	73.5
2013	71.9	68.1	75.6	74.0	70.1	77.6	70.5	66.8	74.3
2014	71.5	67.5	75.4	74.1	70.4	77.5	69.8	65.8	74.0
2015	71.5	67.5	75.5	74.1	70.1	77.8	69.9	65.9	74.1
2016	72.2	68.1	76.2	75.0	71.3	78.4	70.3	66.2	74.7
1990-2016, %	**6.2**	**6.7**	**5.9**	**6.9**	**7.1**	**6.7**	**5.1**	**4.5**	**6.3**

Source: <http://statbank.statistica.md/pxweb/pxweb/ro/20%20Populatia%20si%20procesele%20demografice/20%20Populatia%20si%20procesele%20demografice__POP020/POP020700.px/?rxid=2345d98a-890b-4459-bb1f-9b565f99b3b9>

Table 1-8: The Mortality Rates on the Right Bank of Dniester, during 2005-2016, by Disease Classes, per 1000 Residents

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Disease classes - total	**678.5**	**655.3**	**664.9**	**685.5**	**736.3**	**736.0**	**759.3**	**753.5**	**770.1**	**772.1**	**796.7**	**811.7**
Infectious and parasitic diseases	39.0	36.9	37.4	46.5	37.9	38.1	35.8	34.6	34.1	33.7	33.2	32.7
Tumors	20.6	20.7	21.4	22.3	23.7	26.3	25.9	21.2	20.6	21.1	21.2	21.8
Endocrine, nutritional and metabolic diseases	26.7	27.6	28.6	29.6	30.8	35.6	40.0	45.4	51.9	56.4	60.6	65.0
Diseases of the blood and blood forming organs and certain disorders involving the immune mechanism	14.0	13.8	14.0	13.7	13.8	14.0	14.9	14.8	13.4	14.0	13.9	13.5
Mental and behavioral disorders	44.4	45.5	44.6	48.5	46.7	43.5	46.4	46.3	46.4	44.9	42.4	42.7
Diseases of the nervous system and sense organs	54.3	49.7	48.1	47.8	49.2	50.9	53.6	55.7	52.0	51.3	51.2	50.7
Diseases of the circulatory system	92.3	98.8	110.2	116.2	123.4	125.0	132.5	141.7	151.5	160.4	163.9	183.8
Respiratory diseases	132.0	121.0	119.8	111.4	155.7	130.9	149.1	127.9	144.8	136.4	155.8	154.1
Intestinal diseases	80.9	78.3	80.8	82.3	88.0	93.2	97.3	95.4	92.7	93.2	93.5	89.8
Diseases of the genitourinary system	51.1	47.0	46.6	47.1	48.3	48.9	51.2	54.2	52.2	53.5	51.9	51.5
Complications of pregnancy, childbirth and the puerperium	42.1	36.7	36.0	41.6	43.5	48.9	50.6	50.7	47.6	46.7	46.0	41.4
Diseases of the skin and subcutaneous tissue	30.1	27.3	26.3	24.4	23.4	24.1	22.5	23.6	20.6	19.9	19.9	19.7
Osteoarthritis, muscle and connective tissue diseases	29.9	29.9	30.6	31.2	31.8	33.9	35.3	39.2	37.2	39.5	41.1	40.8
Congenital malformations, deformations and chromosomal abnormalities	3.7	3.7	3.5	3.6	3.4	3.8	4.0	4.2	4.3	4.2	4.2	4.2
Traumas, intoxications and other consequences of external causes	42.7	40.6	38.6	45.9	44.9	52.4	34.9	36.4	34.2	29.7	30.1	28.9

Source: <http://statbank.statistica.md/pxweb/pxweb/ro/30%20Statistica%20sociala/30%20Statistica%20sociala__08%20SAN__SAN020/SAN020200.px/table/tableViewLayout1/?rxid=9a62a0d7-86c4-45da-b7e4-fecc26003802>

The mortality breakdown analysis has demonstrated that diseases of the circulatory system are the main cause of death (22.6 per cent), followed by respiratory diseases (19.0 per cent), intestinal diseases (11.1 per cent), endocrine, nutritional and metabolic diseases (8.0 per cent), followed by diseases of the genitourinary system (6.3 per cent), diseases of the nervous system and sense organs (6.2 per cent), mental and behavioral disorders (5.3 per cent), complications of pregnancy, childbirth and the puerperium (5.1 per cent), osteoarthritis, muscle and connective tissue diseases (5.0 per cent), infectious and parasitic diseases (4.0 per cent), traumas, intoxication and other consequences of external causes (3.6 per cent), tumors (2.7 per cent), diseases of the skin and subcutaneous tissue (2.4 per cent) and diseases of the blood and blood forming organs and certain disorders involving the immune mechanism (1.7 per cent).

According to the data provided by the Ministry of Health, Labor and Social Protection, in 2016, the mortality rate increased on several infectious diseases such as: viral hepatitis – by 2.2 times (837 cases in 2016 compared to 379 cases in

2015), epidemic parotiditis – by 159.1 per cent (105 cases in 2016 compared to 66 cases in 2015) and varicella – cu 136.4% (10 891 cases in 2016 compared to 7987 cases in 2015). At the same time, in 2016 a decreasing trend was recorded regarding the number of bacterial dysentery (81 cases in 2016 compared to 111 cases in 2015), tuberculosis of the respiratory organs (2325 cases in 2016 compared to 2413 cases in 2015), flu (1642 cases in 2016 compared to 1965 cases in 2015), syphilis (1501 cases in 2016 compared to 1809 cases in 2015), pediculosis (2546 cases in 2016 compared to 3148 cases in 2015) etc.

Within the structure of infectious diseases, the most widely spread remain the acute respiratory infections. In 2016, per 100 thousand people, on average there were 7.9 thousand cases of acute respiratory diseases, the highest incidence being recorded in Balti and Chisinau municipalities, respectively with 18.8 thousand cases and 12.2 thousand cases per 100 thousand people. In comparison, the situation in the territory was as follows: Anenii Noi – 11.5 thousand cases per 100 thousand people, Singerei and Criuleni with – 9.7 thousand cases etc.

Nearly every second case of multiple-site acute respiratory infections is recorded on children. The highest incidence was recorded in Chisinau municipality – (64.4 thousand or 50.1 thousand cases per 100 thousand people), mun. Balti (21.1 thousand or 84.2 thousand cases per 100 thousand people), districts Anenii Noi (6.9 thousand or 40.8 thousand cases per 100 thousand people), Hincesti (6.1 thousand or 23.9 thousand cases per 100 thousand people), Ialoveni (5.9 thousand or 26.9 thousand cases per 100 thousand people), Ungheni (5.7 thousand or 22.0 thousand cases per 100 thousand people) etc.

It is recorded a decrease in the case of "socially constructed" diseases, in particular regarding pediculosis and gonococcal infections, with 602 and, respectively, 160 cases.

In 2016, there were recorded 603 HIV cases or with 29 more than in 2015, the overall HIV incidence is 16.9 cases per 100 thousand people (16.2 cases in 2015). At the same time, 241 AIDS cases were recorded.

To be noted that between 2000 and 2015, the overall mortality rate varied significantly. The overall mortality rate is an integral indicator among those defining the state of public health. The mortality breakdown analysis has demonstrated that in 2015, the cardiovascular pathologies was still the main cause of death (57.7 per cent), followed by tumors (15.1 per cent), intestinal diseases (9.4 per cent), traumas, intoxication and other consequences of external causes (6.9 per cent) and respiratory diseases (4.6 per cent) (Table 1-9). It should be noted that during 2000-2015 the rates of mortality, caused by tumors tended to increase.

The mortality rates by region are not uniform, registering dramatic differences between the regions. In 2015, the lowest mortality rates were reported in the municipality of Chisinau and in Balti, whereas the highest rates in Donduseni, Briceni, Edinet, Drochia, Riscani, Floresti, Glodeni, Ocnita, Soldanesti and Rezina. In the recent years, the Republic of Moldova has made considerable efforts to improve the national public health situation.

Table 1-9: The mortality rates in the RM (Right Bank of Dniester River) during 2000-2015, by the main cause of death (per 100 thousand residents)

Year	Tumors	Diseases of the circulatory system	Respiratory diseases	Intestinal diseases	Traumas and intoxication	Total
2000	125.0	632.0	69.4	103.4	92.9	1132.8
2001	128.2	618.2	64.6	109.5	98.4	1103.8
2002	134.7	654.8	74.4	110.0	98.4	1155.4
2003	138.5	679.6	79.0	114.1	103.2	1192.6
2004	141.5	653.7	69.3	116.3	101.6	1156.4
2005	145.8	700.1	79.2	128.6	108.4	1243.2
2006	153.4	671.4	72.9	122.5	105.0	1203.2
2007	150.6	675.9	72.1	119.4	101.9	1203.6
2008	155.2	657.4	68.9	112.3	99.4	1175.0
2009	158.7	663.2	64.7	115.5	97.0	1181.8
2010	157.6	688.1	68.3	121.9	103.6	1224.9
2011	158.3	633.4	53.4	100.2	86.3	1102.5
2012	161.1	641.6	48.8	103.1	86.6	1111.4
2013	163.8	621.9	48.1	94.5	79.8	1069.5
2014	167.1	642.5	48.0	101.7	85.3	1110.5
2015	170.1	648.2	51.6	106.0	77.2	1122.8

Source: Statistical Yearbooks of the RM for 2016 (p. 73), 2015 (p. 50), 2014 (p.52), 2013 (p.52), 2012 (p. 52), 2011 (p. 52), 2010 (p. 52), 2009 (p. 52), 2008 (p. 56), 2006 (p. 65), 2005 (p. 54), 2003 (p. 67), 2001 (p. 53).

1.3.5. Education

The Ministry of Education, Culture and Research, the Municipal Education Departments, Regional General Departments of Education and educational establishments are responsible for the delivery of the primary, secondary general, secondary professional, secondary vocational and university (higher) education. The legal framework for the education system is the Concept Paper on education development in the Republic of Moldova and the Curriculum by disciplines.

Primary and secondary general education. At the beginning of the 2016/17 school year, the Republic of Moldova (Right Bank of Dniester) had 1291 operating primary and secondary general educational establishments, including 122 primary schools, 788 gymnasiums, 366 lyceums and 15 specialized schools for children with mental or physical development deficiencies. Compared to the previous year the number of primary and secondary general educational institutions decreased by 32 units. The public sector is represented by 1275 institutions, while the number of private institutions reached 16 units. The number of institutions in urban areas decreased by six units compared to the previous school year representing 320 units, while 971 institutions operate in rural areas (with 26 de units less). Of the total institutions operating in urban areas, 68 per cent are represented by lyceums, while in rural areas 74 per cent are gymnasiums. In rural areas, 20 primary schools and 6 gymnasiums ceased their activity. Also, 23 lyceums changed their status to gymnasiums, while 22 gymnasiums were reorganized into primary schools. At the beginning of school year 2016-2017, the total number of students enrolled in primary and secondary general educational establishments was 333.7 thousand (Figure 1-3), similar to the previous year. Most of the students enrolled in primary and secondary general educational establishments (98.6 per cent) study in public institutions, while 4.8 thousand students are enrolled in private institutions. On average, per 10 thousand people there are recorded 939 students enrolled in primary and secondary general educational establishments, compared to 941 in 2015-2016 school year.

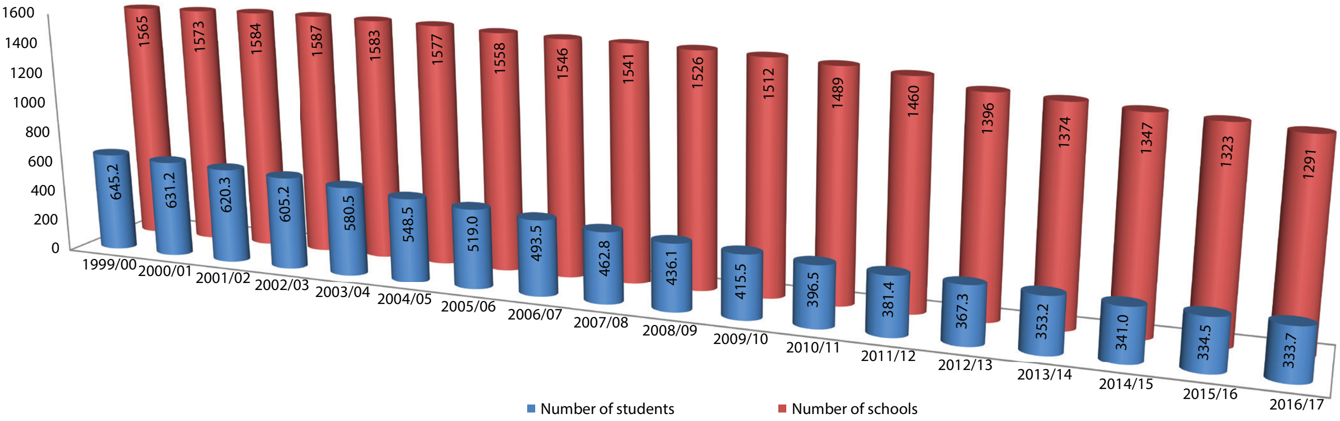


Figure 1-3: Number of Schools, Gymnasiums and Lyceums (units) and Number of Students (thousand) in the Republic of Moldova.

In the last years, the students structure on educational levels show that students enrolled in primary schools increase, representing 41.8 per cent in the current year. The share of students enrolled in gymnasiums is 47.8 per cent, while 10.4 per cent of the students are enrolled in lyceums.

Secondary professional education. During the school year 2016-2017, the number of secondary professional educational establishments represented 86 units, of which 11 centers for excellence, 32 colleges and 43 professional schools. At the beginning of 2016-2017 school year, the number of students enrolled in the secondary professional education represented 19.0 thousand students (Figure 1-4), an increase by 18.0 per cent compared to the previous year. The increase was determined by the increase of the instruction programme from one to two years (based on gymnasium education) due to the reforming process in secondary professional education. In 2016-2017 school year, 8.3 thousand students were enrolled in professional secondary education establishments, or by 11.7 per cent less compared to the previous year. Most of the students were enrolled based on gymnasium education (93.1 per cent). Programme distribution reveals that 68.5 per cent of the total students enrolled have opted for learning a profession (by 11 per cent more than the previous year), 23.7 per cent – for learning related professions (for the first time), 3.4 per cent – for dual education (by 2.3 per cent more) and 4.4 per cent for learning a profession based on lyceum education or secondary general education (by 3.7 per cent less).

In the school year 2016-2017, the most demanded professions/occupations are: cook (7.3 per cent of the total number of enrolled students), car mechanic (7.3 per cent), computer operator (5.4 per cent), plasterer (4.9 per cent), welder-fitter (electric and gas welding) (4.0 per cent), tailor (3.1 per cent), dressmaker (2.8 per cent), etc. At the same time, some of these professions are included in related professions category. Thus, the most demanded related professions are: welder-fitter (electric and gas welding)– gas cutter (4.6 per cent), tailor/dressmaker (3.2 per cent), electrical equipment assembly – locksmith -electrician electric equipment (3.1 per cent), cook-waiter (2.4 per cent), electrician-automotive electronics– car mechanic (2.1 per cent), plasterer – tilling (1.6 per cent) etc. In 2016, the number of graduates represented 3.6 thousand students, by 60 per cent less compared to the previous year.

Secondary vocational education. In the school year 2016-2017, the secondary vocational education was organized in 43 colleges. At the beginning of 2016-2017 school year, the total number of students represented 29.8 thousand (Figure 1-5), a slight decrease compared to the previous year (by 2.0 per cent). Most of the students were enrolled in state colleges (94.1 per cent of the total).

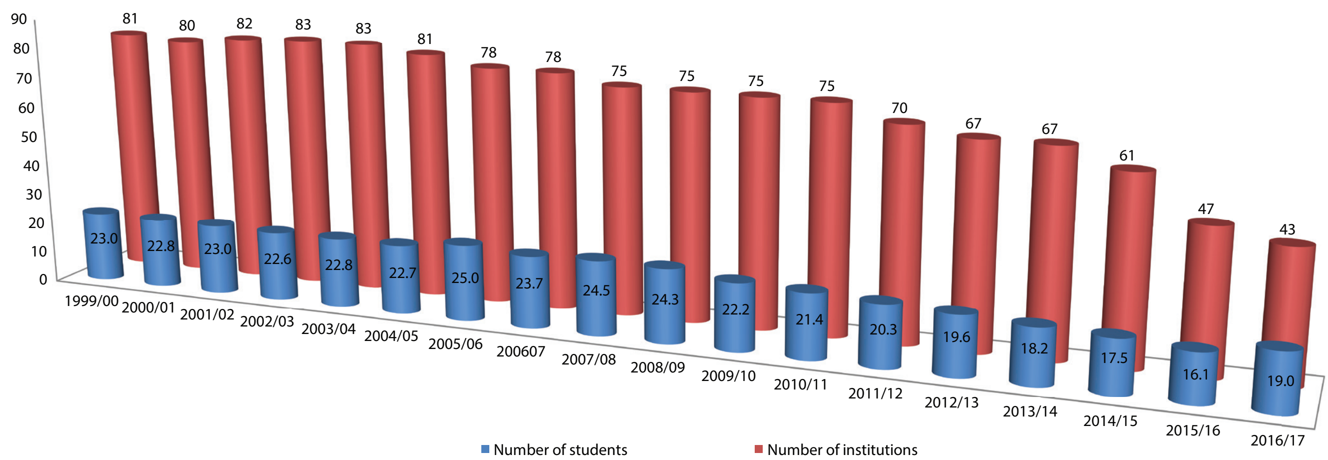


Figure 1-4: Number of Secondary Professional Educational Establishments (units) and Number of Students (thousand) in the Republic of Moldova.

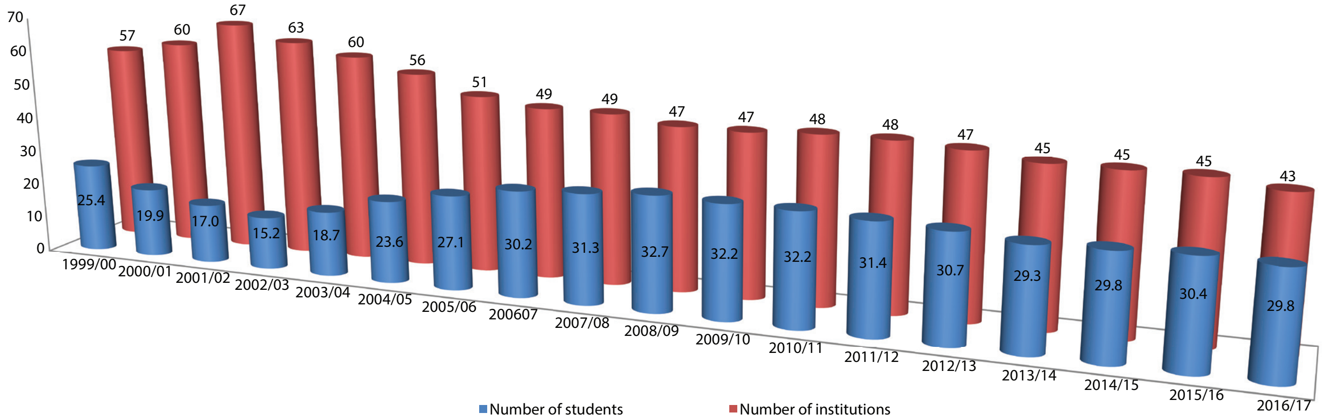


Figure 1-5: Number of Secondary Vocational Educational Establishments (units) and Number of Students (thousand) in the Republic of Moldova.

In the school year 2016-2017, 8.2 thousand students were enrolled in secondary vocational education, decreasing by 7.9 per cent compared to the previous year. Of the total enrolled, circa 90 per cent were enrolled based on gymnasium education. 3.9 thousand students were enrolled with budget financing, by 8.0 per cent less compared to 2015/16. The most demanded sectors were: caretakers (8.3 per cent of the total enrolled), accounting (7.4 per cent), tourism (3.9 per cent), medicine (3.8 per cent), social assistance (3.6 per cent), technical exploitation of car transport (3.1 per cent), hairdressing and cosmetics (3.1 per cent), computer science (3.0 per cent), etc. In 2016, the number of graduates represented 6.8 thousand students, by 8 per cent more compared to the previous year.

Higher Education. In the 2016/17 academic year, the total number of higher education establishments (universities) in the Republic of Moldova was 30 units (Figure 1-6), of which 19 were state-owned and 11 - private. The number of students represented 74.7 thousand or by 7 thousand or 8.6 per cent less compared to the previous year. Most students were enrolled in state-owned universities 83 per cent of the total. The students were distributed as follows: 56.6 thousand were enrolled for a university programme, the first cycle; 13.6 thousand students were enrolled for a master degree programme, the second cycle; 0.8 thousand students – for integrated university studies and 3.7 thousand students were enrolled for a medical and pharmaceutical programme.

In the 2016/17 academic year, the universities had 15.4 thousand first-year students enrolled for the first cycle (by 12.8 per cent less compared to the previous year) and 6.7 thousand enrolled for the second cycle (in decrease by 2.9 per cent). The number of students enrolled for the first cycle funded from the budget decreased by 6.3 per cent compared to the previous year, representing 5.4 thousand, while the number of students enrolled for the second cycle funded from the budget represented 3.7 thousand, similar to the previous year. Over three fourth of the total number of students were enrolled for the first cycle based on lyceum education. Among the specialty areas the biggest share of first-year students chose: economy – 23.0 per cent of the total first year students, education – 14.7 per cent, engineering – 12.2 per cent, law – 11.3 per cent. As for the second cycle, the students enrolled for a master degree programme had the following preferences: education - 19.8 per cent of the total, followed by economy – 19.6 per cent, law – 18.4 per cent, engineering – 6.7 per cent etc. In 2016, the number of graduates for the first cycle represented 15.1 thousand students, the second cycle – 6.1 thousand students while 0.6 thousand students graduated the medical and pharmaceutical programme.

Post-graduate education. Among the total of research (R&D) institutions operating in the Republic of Moldova as at the beginning of 2015, 43 institutions offered post-graduate studies (doctoral degree). The total number of postgraduate students represented 1751, recording a significant increase by +46.5 per cent compared to 1999 (Figure 1-7).

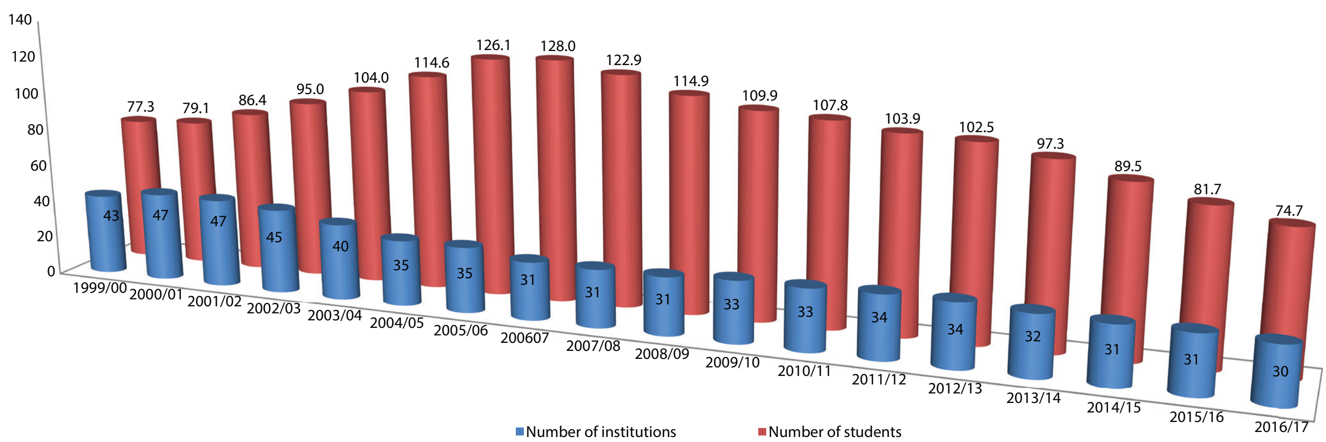


Figure 1-6: Number of Higher Education Establishments (units) and Number of Students (thousand) in the Republic of Moldova.

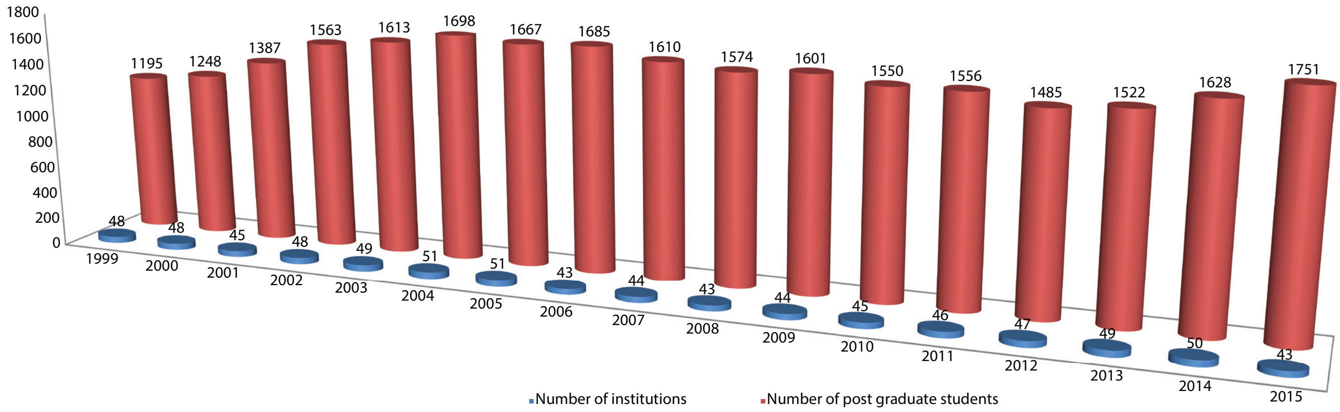


Figure 1-7: Number of Institutions (units) Providing Post Graduate Education and Number of Post Graduate Students (persons) in the Republic of Moldova.

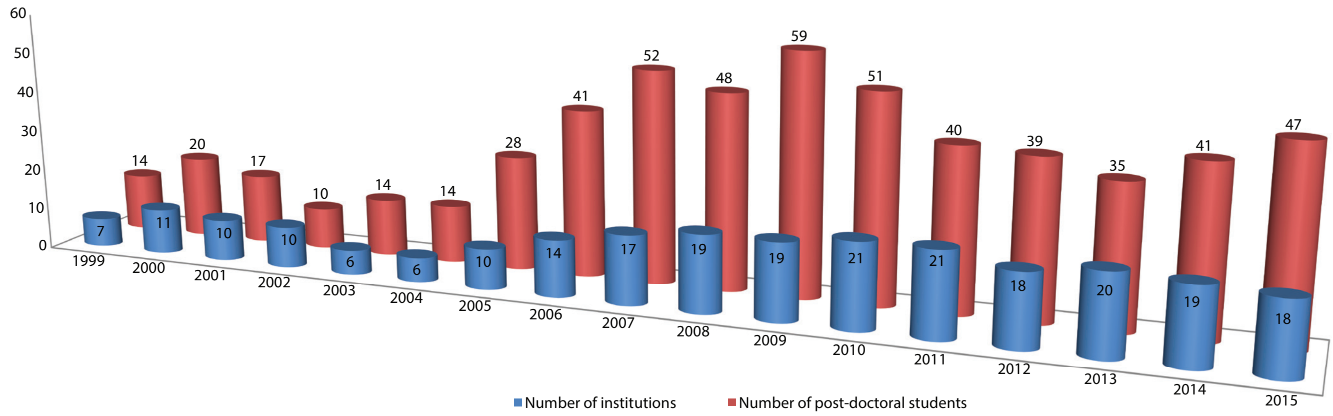


Figure 1-8: Number of Institutions (units) Providing Post-Doctoral Education and Number of Post-Doctoral Students (persons) in the Republic of Moldova.

At the beginning of 2013, the number of the institutes offering post-doctoral studies was 18 units (Figure 1-8). The total number of post-doctoral students was 47. In 2015, the total number of post-doctoral students grew by 3.4 times compared to 1999.

1.4. Institutional Arrangements

1.4.1. Institutions

The Republic of Moldova proclaimed its independence on August 27, 1991 though it remained however a part of the Soviet Union until the latter's formal dissolution in December of 1991. The RM's new constitution was approved in the national referendum and ratified by the Parliament on July 28, 1994. According to the Constitution, the Republic of Moldova is a neutral country. The Constitution guarantees the voting right to all its citizens who have reached the age of 18 and provides for the various civil rights and liberties.

The President is the head of the state and is directly elected every 4 years (and may occupy this position for at most two consecutive terms). The President has the power to dissolve the Parliament. The Constitution provides for the possibility to accuse the President of a penal or constitutional infringement.

The President appoints the Prime Minister and (upon the latter's recommendations) the Cabinet of Ministers. The Prime Minister and the Cabinet require the approval of the Parliament. The current Government, invested on January 20, 2016 is comprised of 16 ministries, but as of July 26, 2017, in the context of the Parliament's vote on the new structure of the Executive, due to the transfer of competences, out of 16 only 9 ministries remained, including:

1. Ministry of Economy and Infrastructure,
2. Ministry of Finance,
3. Ministry of Justice,
4. Ministry of Internal Affairs,
5. Ministry of Foreign Affairs and European Integration,
6. Ministry of Defense,
7. Ministry of Education, Culture and Research,
8. Ministry of Health, Labor and Social Protection,
9. Ministry of Agriculture, Regional Development and Environment.

The nation's supreme legislative authority is the one-chamber Parliament. It is composed of 101 deputies elected directly for the term of four years. The Parliament has two ordinary sessions per year; furthermore, it is possible to convene an extraordinary parliamentary session. In addition to adoption of laws and exercising other basic legislative functions, the Parliament may declare the state of national emergency, martial law or war.

The judiciary system includes three supreme courts: the Supreme Court of Justice, the Court of Appeals and the Constitutional Court – the supreme authority on constitutional issues issuing final decisions, which cannot be appealed against. Tribunals and courts exercise judicial procedures at the local level. The President appoints judges for the Supreme Court of Justice and the Court of Appeals from the nominees submitted by the Supreme Council of Magistrates.

The Supreme Council of Magistrates composed of 11 magistrates and elected for a five-year term is in charge of appointments, transfers and promotions of judges. The Council includes the Minister of Justice, the Chairman of the Supreme Court of Justice, the Chairman of the Court of Appeals, the Chairman of the Economic Court and the Attorney General, three members elected from among the members of the Supreme Court of Justice and another three members elected by the Parliament from among the accredited university professors.

1.4.2. Institutional Arrangements Relevant for NCs, BURs and NIRs Preparation

The Ministry of Agriculture, Regional Development and Environment (MARDE) of the Republic of Moldova is the state authority responsible for the following areas: (1) agriculture; (2) food production; (3) food safety; (4) regional and rural development; (5) spatial planning; (6) environment protection and climate change; (7) natural resources.

The main responsibilities of the Ministry are:

- develop and promote policies, normative acts in the areas of competence;
- collaboration, according to the national legislation, with foreign institutions in the areas of competence;
- implementation of normative acts and international environment treaties to which the Republic of Moldova is a Part, reporting on their execution;
- examination and approval of draft normative acts elaborated by other public administration authorities and sent for examination;
- elaborating and presenting budget proposals in the areas of competence, elaborating the annual activity plan, as well as annual monitoring of implementation degree by generating and publishing the respective reports;
- organizing the planning, execution, financial accounting and budget reporting systems within the Ministry and, as necessary, within the subordinated budget authorities/ institutions;
- coordination and monitoring of administrative authorities activities, of the subordinated decentralized public services and of the public institutions in which it represents a founder;
- exercising other specific functions.

On behalf of the Government of the Republic of Moldova, MARDE is responsible for implementation of international environment treaties to which the Republic of Moldova is a Part (including the United Nations Framework Convention on Climate Change, signed by the Republic of Moldova on June 12, 1992, ratified by the Parliament on March 16, 1995, as well as the Kyoto Protocol, ratified by the Republic of Moldova on February 13, 2003, the official date of accession being April 22, 2003). One of the State Secretaries of the Minister of Agriculture, Regional Development and Environment is also the UNFCCC National Focal Point.

Through the Government Decision No. 1574 as of 26.12.2003 it was established the *„National Commission for Implementing Provisions of the United Nations Framework Convention on Climate Change and Provisions and Mechanisms of Kyoto Protocol”*. In conformity with Article 2 of its working regulations, the *„National Commission”* is the supreme authority in the Republic of Moldova responsible for implementation of the UNFCCC provisions, as well as the mechanisms and provisions of Kyoto Protocol.

The National Commission was vested with full authority to develop and promote policies and strategies under the Clean Development Mechanism of the Kyoto Protocol. The respective National Commission collaborates with the Inter-Ministerial Committee for Sustainable Development and Poverty Reduction, the Commission for European Integration, the National Council for Participation, as well as with other Commissions and National Committees.

The activity of the National Commission and execution of its decisions is coordinated and monitored by the National Commission's Secretary, who is also the Manager of the Climate Change Office under the MARDE.

The Climate Change Office was established through the Ministerial Order No. 21 as of February 11, 2004 of the Ministry of Ecology, Constructions and Territory Development of the Republic of Moldova (reorganized into Ministry of Environment and Natural Resources based on Government Resolution No. 357 as of April 23, 2005 'On reorganization of ministries and central administration authorities of the Republic of Moldova'; based on Law No. 21-XVIII as of September 18, 2009, the Ministry of Environment and Natural Resources was reorganized into the Ministry of Environment).

The main tasks of the CCO are:

a) providing logistical support to the Government, central and local public administration authorities, non-government and academic organizations, in activities implemented and promoted by the RM under the UNFCCC and Kyoto Protocol; and
b) implementing climate change related projects and programs providing for such activities as: GHG emissions evaluations and national inventory reports preparation; development and implementation of GHG emissions mitigation activities; development and implementation of measures aimed to adapt to climate change; assessment of the climate change impact on environment and socio-economic components; cooperation, promotion and implementation of activities and projects under the Clean Development Mechanism (CDM) of the Kyoto Protocol; implementation and facilitation of activities aimed at building awareness and information among civil society, relevant experts and decision makers in climate change related issues, etc.

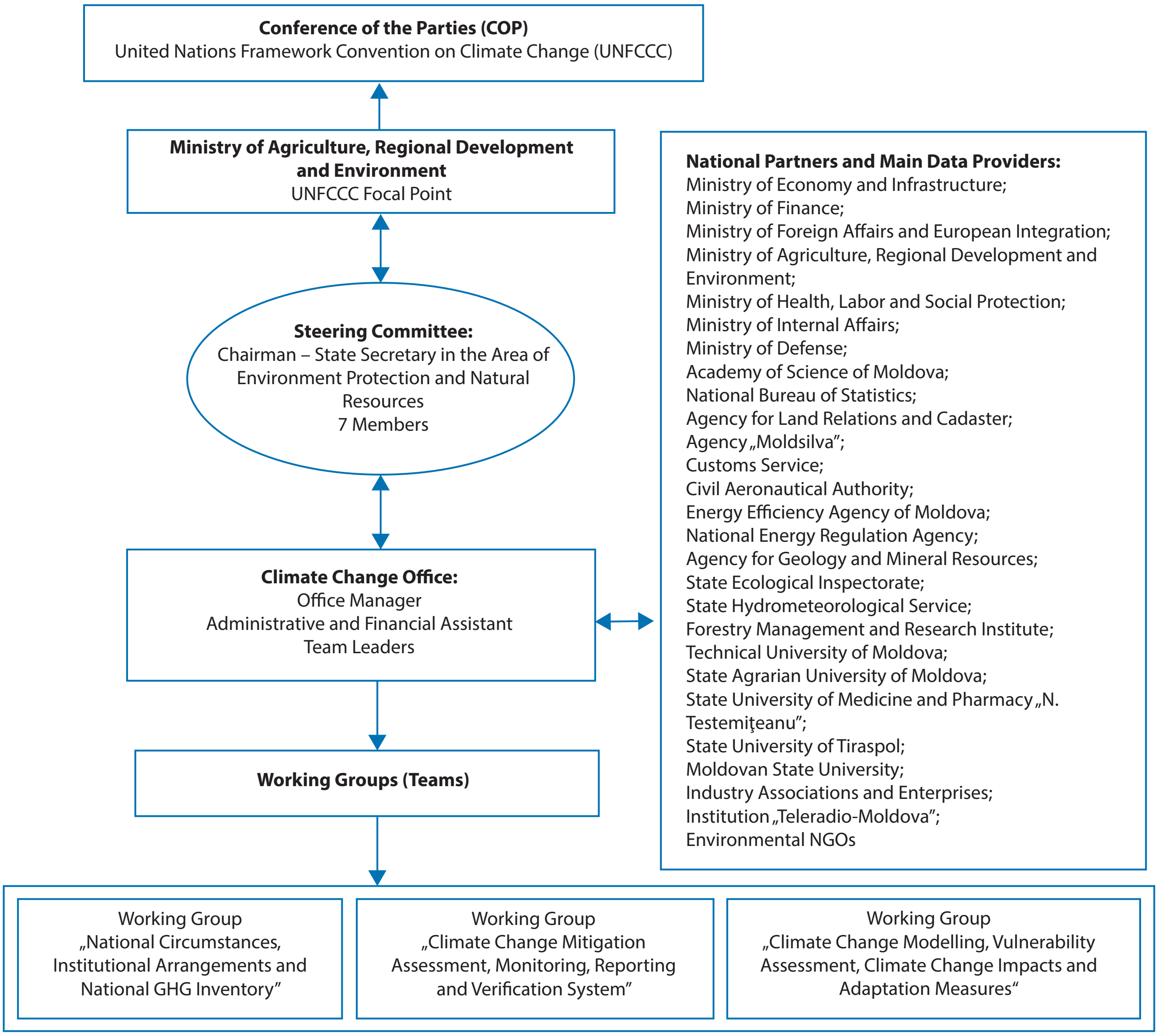


Figure 1-9: Institutional Arrangements Relevant for the Preparation of the National Communications, Biennial Update Reports and National Inventory Reports in the Republic of Moldova.

The role of CCO is also specified within the *Government Decision No. 141 dated 24.02.2014 on creating the energy statistical system*. Thus, Chapter 2.1, Paragraph 3(h) notes that the Climate Change Office is responsible for developing national inventories of direct (CO_2, CH_4, N_2O, HFC, PFC and SF_6) and indirect greenhouse gases (NO_x, CO, NMVOC and SO_2), originated from six sectors (Energy, Industrial Processes, Solvents and Other Products Use, Agriculture, LULUCF and Waste).

Since its creation, the Climate Change Office was and remains fully responsible for activities related to the preparation of National Communications, while since 2014, as well of the Biennial Update Reports of the Republic of Moldova under the UNFCCC (Figure 1-9).

The Climate Change Office comprises three working groups: "National Circumstances, Institutional Arrangements and National GHG Inventory", "Climate Change Mitigation Assessment, Monitoring, Reporting and Verification System", and "Climate Change Modelling, Vulnerability Assessment, Climate Change Impacts and Adaptation Measures". Below is a brief description of functional responsibilities of the participants in the process:

- National experts (hired on a contract basis) are responsible for the process of activity data gathering, selecting suitable assessment methods, assessment at sectoral level, taking correction measures as a response to quality assurance and quality control activities as well as developing some component parts of the National Communications, Biennial Update Reports and National Inventory Reports.
- Team leaders are responsible for the coordination of the process of compilation of the key parts of the National Communications, Biennial Update Reports and National Inventory Reports. They supervise the process at sectoral level, are responsible for interpreting the results obtained by national experts, coordination of quality assessment and quality control activities, documentation and archiving the materials used and aggregating the reports submitted by national experts.

The activity data needed for the National Communications, Biennial Update Reports and National Inventory Reports compilation are available in Annual Yearbooks, Energy Balances and others sectoral statistic publications of the National Bureau of Statistics of the Republic of Moldova.

Additional statistical data may be provided at request, in conformity with provisions of the *Law No. 412 as of 09.12.2004 on Official Statistics, Article 9 (2), item a) and b)*, according to which *"the official statistics authorities must disseminate statistical data to users in the amount, manner and terms specified in the statistical works programme"*, as well as to *"to ensure access of all users to non-confidential statistics on equal conditions in terms of amount and terms of dissemination"*.

Also, based on the provisions of the *Law on Access to Information*, adopted by the Parliament Resolution No. 982-XIV as of 11.05.2000, other relevant activity data was/is collected periodically from various partner organizations and data providers, such as:

- Central Public Authorities and Subordinated Institutions:
  - Ministry of Economy and Infrastructure;
  - Ministry of Finance;
  - Ministry of Agriculture, Regional Development and Environment;
  - Ministry of Internal Affairs;
  - Ministry of Health, Labor and Social Protection;
  - Ministry of Defense;
  - National Agency for Energy Regulation;
  - Customs Service;
  - Energy Efficiency Agency;
  - Civil Aeronautical Authority;
  - Agency for Geology and Mineral Resources;
  - State Hidrometeorological Service;
  - State Ecological Inspectorate;
  - Offices under the Ministry of Agriculture, Regional Development and Environment (Ozone Office, Environmental Pollution Prevention Office).
- Central Administrative Authorities (AAC):
  - National Bureau of Statistics;
  - Land Relations and Cadaster Agency;
  - Agency „Moldsilva".
- Academy of Sciences of Moldova with its institutional members:
  - Institute of Power Engineering;
  - Institute of Ecology and Geography;
  - Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo";
  - Institute of Scientific and Practical Animal Husbandry and Veterinary Medicine in Biotechnology.
- Universities:
  - Technical University of Moldova;
  - State Agricultural University of Moldova;
  - State University of Medicine and Pharmaceutics „Nicolae Testemițeanu";
  - State University of Tiraspol;
  - Moldovan State University.
- Economic Agents:
  - S.E. „Moldavian Railways";
  - M.E. „Autosalubritate";
  - J.S.C. „Moldovagaz";
  - J.S.C. „Moldelectrica";
  - J.S.C. „Termoelectrica" (CHP-1, CHP-2, Termocom);
  - J.S.C Red Union Fenosa SA from Gas Natural Fenosa Group;
  - J.S.C. „Lafarge Ciment (Moldova)";
  - S.E. „Glass Factory in Chisinau";
  - S.E. „Center for State Information Resources „Registru";
  - M.E „Glass Container Company" J.S.C.;
  - J.S.C. „Macon".
- Industry Associations:
  - Public Association of Refrigerating Engineers in the Republic of Moldova;
  - Union of Moldovan Sugar Producers.

Article 1 of the *Law on Access to Information* regulates the relationships between information providers and individual/legal entity in the process of ensuring and implementing the constitutional right of access to information; principles, conditions, ways and manner of accomplishing access to official data owned by information providers; aspects of access to and protection of personal information within the scope of access to such data; rights of data solicitants, including petitioners of personal data; obligations of information providers in the process of ensuring access to official information; ways to protect the right to access to information. Article 4 (1) stipulates that *"anyone, under this law's conditions, has the right to look for, receive and make public official information"*. According to Article 6 (1), *"official information are deemed to be all information owned and available to information providers, developed, selected, processed, consolidated and /or adopted by authorities or official persons or made available to them by other legal entities"*. This Article is a review of information bearing documents as stipulated by the provisions of this law. Article 7 refers to cases of limited access to official information. Rights of data solicitants are reflected in Article 10, while Article 11 refers to the obligations of information provider. According to Article 13 (1), ways of access to information are the following: hearing of information which can be provided verbally; document review on the premises of the institution; issuing a copy of the requested document or information; issuing a copy of the document, information translated into a different language than the language of the original, for an additional charge; sending by mail (including e-mail) of a copy of the document, information, a copy of the translated document, information into a different language, at the solicitant's request, for a payment. Article 13 (2) stipulate that extracts from registers, documents, information, as per solicitant's request, can be made available to the solicitant in a reasonable and acceptable to the solicitant form.

Article 16 of the Law refers to the requirements that have to be met to ensure access to information: the requested information or documents shall be made available to the solicitant from the moment it becomes available for issuing, but not later than 15 working days from the date the application for access to information is registered; the leadership of the public institution may extend the term of providing the information, or document by 5 working days if : (i) the request refers to a very big volume of information requiring their selection; (ii) additional consultations are needed to satisfy the request. The solicitant will be informed about any extension of the information delivery term and about the reasons for such extension 5 days prior to the expiry of the initial term. The Law also refers to cases when access to information is denied, to payments for official information provision, to modalities of protecting the right for access to information and prosecution in court of information providers' actions.

Also, a series of other laws contain provisions pertaining to wide public to environment protection related information. Thus, Article 29 (3) of the *Law on Natural Resources*, adopted by the Parliament Decision No. 1102-XIII as of 06.02.1997, stipulates that *„Government, local public administration authorities, state bodies assigned with natural resources management and environment protection, as well as businesses, shall make public valid and accessible information regarding natural resources use and environment protection activities"*. Article 23 of the *Forestry Code*, adopted by the Parliament Decision No. 887 as of 21.06.1996, stipulates that citizens and NGO-s are entitled to receive information from the state forestry authorities and environment protection bodies about forestry and hunting resources, planned and accomplished conservation measures and use of such resources. The *Regulation regarding trading and regulated use of halogenated hydrocarbons that deplete the ozone layer*, approved by the *Law of the Republic of Moldova No. 852-XV as of 14.02.2002*, stipulates the procedure of presenting by the MENR of information regarding production, import, export, trading and use (recycled and reclaimed quantities of controlled substances) of halogenated hydrocarbons that deplete the ozone layer, regulated by Montreal Protocol.

1.5. Economical Context

After the breakup of the Soviet Union and declaration of the Republic of Moldova's independence, the nation had to face a particularly severe crisis in view of both the size of the country and the scope of the crisis as compared to the other economies in transit. The Republic of Moldova rated among the medium - low income countries in 1991, and it has turned currently to one of the lowest income country in Europe, with its per capita GDP below the average for both the Commonwealth of Independent States (CIS) and the Central European countries. In terms of its structure, the Republic of Moldova's economy is closer to that of the Central Asia republics than that of the other more western former Soviet Union Republics.

1.5.1. Gross Domestic Product

The separatist actions of the industrialized Transnistrian region (i.e., the current administrative-territorial units on the left bank of the Dniester) have left the RM with an undiversified economic base, dependent in practical terms solely on the agricultural production and food industry. In 1993, the agricultural sector accounted for 31.2 per cent of GDP, and the manufacturing industry – for 39.0 per cent of GDP. By 2016, the share of GDP accounted for by the agriculture decreased to 12.2 per cent, and that of the manufacturing industry to 15.1 per cent of the GDP (Table 1-10).

Table 1-10: GDP Structure in the Republic of Moldova within 1993-2016 periods, %

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
GDP structure, %	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Gross Value Added	99.0	93.4	88.6	87.5	86.0	84.6	89.3	87.5	88.0	87.3	85.2	85.9
Production, total	70.2	58.6	54.3	50.6	46.2	42.5	41.9	41.7	41.1	38.3	35.9	34.7
Agriculture	31.2	27.3	29.3	27.5	26.0	25.8	24.9	25.4	22.4	21.0	18.3	17.6
Industry	39.0	31.4	25.0	23.1	20.2	16.7	17.0	16.3	18.7	17.3	17.6	17.1
Services, total	32.9	38.6	36.6	41.7	43.5	46.9	53.0	48.2	49.2	51.0	51.6	53.5
Wholesale and Retail Trade	7.9	7.8	8.0	8.3	8.2	10.3	15.3	12.5	12.0	11.0	10.7	10.6
Transports and Communications	4.4	6.3	5.1	5.6	6.5	7.4	8.2	9.5	10.4	10.0	10.8	11.8
Construction Sector	3.3	4.5	3.5	3.8	4.7	3.2	3.3	2.7	3.1	2.9	2.9	3.4
Financial Sector	4.8	5.2	3.7	6.6	6.0	7.4	8.2	5.3	4.5	4.3	4.5	4.7
Other	12.5	15.0	16.3	17.4	18.2	18.7	18.0	18.2	19.2	22.7	22.6	23.0
Agent (Intermediary) Services	-4.1	-3.9	-2.2	-4.7	-3.8	-4.8	-5.6	-2.4	-2.3	-2.1	-2.3	-2.3
Product and Import Taxes, Net	1.0	6.6	11.4	12.5	14.0	15.4	10.7	12.5	12.0	12.7	14.8	14.1

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP structure, %	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Gross Value Added	84.0	83.4	83.1	82.3	84.1	83.4	83.0	83.5	83.3	84.3	84.8	85.2
Production, total	32.2	29.2	24.2	22.7	21.8	25.3	26.2	25.2	26.6	27.6	27.5	27.3
Agriculture	16.4	14.5	10.0	8.8	8.5	12.0	12.3	11.2	12.3	13.0	12.2	12.2
Industry	15.8	14.7	14.3	13.9	13.3	13.3	14.0	14.0	14.3	14.5	15.2	15.1
Services, total	53.8	56.7	61.2	61.7	63.9	60.1	59.0	60.3	58.4	58.6	60.5	59.4
Wholesale and Retail Trade	10.4	11.5	12.6	13.0	13.2	12.8	13.5	13.7	13.6	13.7	13.7	14.3
Transports and Communications	12.2	11.8	12.3	12.1	12.0	11.3	10.9	10.7	10.0	9.6	10.9	10.8
Construction Sector	3.3	4.0	4.8	5.0	3.5	3.4	3.3	3.4	3.4	3.6	3.6	3.3
Financial Sector	4.6	5.0	6.0	6.0	6.4	5.7	5.0	4.7	4.4	4.5	6.4	5.4
Other	23.2	24.5	25.4	25.7	28.9	26.9	26.2	27.7	27.0	27.2	25.9	25.6
Agent (Intermediary) Services	-2.0	-2.5	-2.3	-2.1	-1.6	-2.1	-2.2	-2.0	-1.7	-1.9	-3.3	-1.5
Product and Import Taxes, Net	16.0	16.6	16.9	17.7	15.9	16.6	17.0	16.5	16.7	15.7	15.2	14.8

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

Nevertheless, the agriculture is still a dominating GDP driver, whereas the industrial sector is based to a considerable extent on food procession. According to the 2016 Statistical Yearbook of the RM, the manufacturing industry accounts for as little as 12.4 per cent of the total employment – as opposed to the agriculture accounting for 31.7 per cent.

It should be noted, that certain economic decline patterns had been registered prior to 1991, but the separation from the USSR has considerably accelerated that process. GDP level was decreasing continuously during the period from 1990 to 1999 inclusive, when it fell down to as little as 34 per cent of the 1990 level. The only exception was 1997 year, when a slight increase by 1.6 per cent versus the previous year was registered due to the excellent agricultural yields as result of the very favorable climate conditions (Tables 1-11, 1-12 and 1-13).

The reasons for the economic collapse were multiple. First, the RM had been integrated completely in the USSR economic system, and the independence resulted, among other things, in the cessation of any subsidies or cash transfers from the centralized government. Second, the end of the Soviet Era with its well established commercial links has resulted in the emergence of multiple obstacles for free movement of products, and in access restrictions introduced by the emerging markets. Third, the lack of domestic energy resources and raw materials in the RM has contributed considerably to the nation's strong dependence on other former Soviet Republics. That dependence has caused a shock in the sphere of imports due to the increased prices of the energy resources imported from the Russian Federation.

Certain internal reasons should be mentioned as well, such as: transition from a centralized economy to a market economy; loss of the industries located in Transnistrian region on the left bank of Dniester; frequent droughts; and the civil conflict.

Despite these problems, the considerable GDP growth achieved since 2000 seems to indicate that the economy is finally developing in the correct direction (excluding 2009, when the country was affected by the regional economic crisis and, respectively, 2012 and 2015, when disastrous droughts affected the RM) although it should be remembered that, according to the latest data available, in 2016 the GDP reached only 72.1 per cent of the 1990 level. Also, the substantial cash inflows from the Moldavians working abroad have somehow reduced the negative impact of the declining economic activity.

Table 1-11: GDP in the Republic of Moldova within 1990-2017 periods, billion MDL

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
GDP, billion MDL (real)	13.0	25.9	191.9	1.8	4.7	6.5	7.8	8.9	9.1	12.3	16.0	19.1	22.6	27.6
% compared to the previous year	97.6	82.5	71.0	98.8	69.1	98.6	94.1	101.6	93.5	96.6	102.1	106.1	107.8	106.6
% compared to 1990	100.0	82.5	58.6	57.9	40.0	39.4	37.1	37.7	35.2	34.0	34.8	36.9	39.8	42.4
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GDP, billion MDL (real)	32.0	37.7	44.8	53.4	62.9	60.4	71.9	82.3	88.2	100.5	112.0	122.6	134.5	148.3
% compared to the previous year	107.4	107.5	104.8	103.0	107.8	94.0	107.1	106.8	99.3	109.4	104.8	99.6	103.8	104.5
% compared to 1990	45.5	49.0	51.3	52.8	57.0	53.6	57.4	61.3	60.8	66.5	69.7	69.4	72.1	75.3

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

Table 1-12: GDP in the RM within 1990-2015 periods, billion US $, updated at the level of 2010

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
GDP, billion 2010 US $	9.894	8.311	5.892	5.821	4.023	3.966	3.760	3.820	3.572	3.450	3.523	3.738	4.029
% compared to the previous year	97.6	84.0	70.9	98.8	69.1	98.6	94.8	101.6	93.5	96.6	102.1	106.1	107.8
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
GDP, billion 2010 US $	4.295	4.614	4.959	5.197	5.356	5.772	5.427	5.812	6.184	6.141	6.718	7.027	6.995
% compared to the previous year	106.6	107.4	107.5	104.8	103.1	107.8	94.0	107.1	106.4	99.3	109.4	104.6	99.5

Source: Economic Research Service, US Department of Agriculture, 22/06/2017, <http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx#.UXFRlKJTCQo>.

Table 1-13: GDP in the Republic of Moldova within 1993-2016 periods, billion US $

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
GDP, billion US $ (real)	1.358	1.165	1.441	1.694	1.929	1.699	1.174	1.289	1.480	1.662	1.981	2.598
% compared to the previous year		85.7	123.8	117.5	113.8	88.1	69.1	109.8	114.9	112.3	119.2	131.1
GDP, billion US $ (PPP)	10.830	10.948	7.586	7.659	8.064	7.622	7.413	7.687	8.352	9.176	9.988	7.307
% compared to the previous year		101.1	69.3	101.0	105.3	94.5	97.3	103.7	108.7	109.9	108.9	73.2
GDP per capita, thousand MDL	0.493	1.287	1.798	2.167	2.440	2.498	3.379	4.402	5.246	6.227	7.646	8.890
% compared to the previous year	96.2	69.3	100.7	94.2	100.1	93.5	96.8	102.3	106.4	108.1	106.9	107.6
thousand US $	0.368	0.317	0.400	0.471	0.528	0.465	0.322	0.354	0.408	0.459	0.548	0.721
thousand US $ (PPP)	2.935	2.975	2.105	2.128	2.207	2.087	2.033	2.112	2.300	2.533	2.765	2.028
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP, billion US $ (real)	2.988	3.408	4.402	6.056	5.438	5.813	7.016	7.286	7.983	7.981	6.512	6.751
% compared to the previous year	115.0	114.0	129.2	137.6	89.8	106.9	120.7	103.8	109.6	100.0	81.6	103.7
GDP, billion US $ (PPP)	8.490	9.190	9.740	10.734	10.091	10.926	11.916	15.035	16.612	14.665	14.583	14.978
% compared to the previous year	116.2	108.2	106.0	110.2	94.0	108.3	109.1	126.2	110.5	88.3	99.4	102.7
GDP per capita, thousand MDL	10.475	12.483	14.937	17.625	16.948	20.181	23.132	24.787	28.244	37.375	40.936	45.401
% compared to the previous year	107.8	105.1	103.2	108.0	94.1	107.2	106.9	99.3	109.4	124.4	99.7	104.9
thousand US $	0.831	0.951	1.231	1.696	1.525	1.632	1.971	2.047	2.243	2.662	2.175	2.279
thousand US $ (PPP)	2.362	2.563	2.723	3.007	2.856	3.101	4.179	4.224	4.668	4.892	4.871	5.057

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

1.5.2. Inflation

The inflation rate grew dramatically up to approximately 788.5 per cent in 1993 and slowed down to 7.7 per cent in 1998. The 1998 year depreciation of the Russian Rubble caused rapid growth of the inflation up to 39.3 per cent (Table 1-14).

Later, the RM achieved a significant progress in terms of controlling its inflation rate, and the inflation rate decreased to 5.2 per cent in 2002; however, the 2003 average inflation rate for the year increased up to 11.7 per cent driven by the growing prices for agricultural products (as result of a severe drought), and the above growth pattern persisted in the subsequent years; the inflation reached 12.4 per cent in 2004, but decreased to 11.9 per cent in 2005 – only to grow up to 12.7 per cent in 2006, in particular due to the increased prices for the natural gas imported from Russian Federation, for fuel and medications. The average inflation rate for the year was about 12.4 per cent in 2007, and the nature of inflation was mainly non-monetary, because it was driven by the growing global prices for oil, increase of the government-regulated tariffs for certain services (utilities) and the growing purchasing power of the population owing to the increased salaries and old-age pensions as well as hard-currency flows to the Republic of Moldova from the Moldavians working abroad. The 2008 inflation rate remained relatively high (12.7 per cent), driven by the growing prices for public utilities, increasing food demand and the growth of the purchasing power. In 2009, the inflation rate represented about 0.006 per cent, increasing up to 7.4 per cent in 2010 and to 7.6 per cent in 2011, in particular, due to the more evident growth of food and fuel prices, and partly being influenced by developments in the foreign exchange market. Within 2012-2013 periods the inflation risk balance continued to be influenced by external and internal factors, with a slight emphasis on post-inflationary factors. The main factors that influenced the average rate of consumption index increase were oil prices on the international markets and increased food prices due to severe droughts. The main disinflation factors this year were represented by lower economic activity and weak domestic and foreign demand. In 2014, the inflation rate was 5.1 per cent, which is by 0.5 percentage points higher compared to the previous year. The price increase was generally due to higher prices for non-food goods, especially fuel, clothing, cars and shoes. In 2015, the average annual inflation rate represented 9.7 per cent, by 4.6 points increased to the level of 2014[7]. During 2015, the annual inflation rate continued to significantly increase. It increased from 4.7 per cent in January to 7.1 per cent in March under the depreciation of the domestic currency, thus exceeding the upper limit of ±1.5 points from the inflation target of 5.0 per cent established in the Medium-Term Monetary Policy Strategy. Subsequently, the annual inflation rate gradually increased to 8.6 per cent in July 2015, influenced by the depreciation effects, as well as by the unfavorable agro-meteorological conditions that exerted pressure on food prices. The increase of the electricity and gas tariff led to a sharp acceleration of inflation to 12.2 per cent in August, and by the end of 2015, inflation rate reached 13.6 per cent. Inflationary pressures during the year were partly mitigated by modest domestic demand, embargoes on some products, as well as the downward trend in international food and oil prices.

During 2016, the annual CPI inflation rate was clearly decreasing, falling from 13.6 per cent in December 2015 to 2.4 per cent in December 2016. In August, it returned in the range of 5.0 per cent ±1.5 points agreed by the Medium-Term Monetary Policy Strategy, representing 3.6 per cent. After that, the annual inflation rate continued its downward trajectory, falling bellow the lower limit of the above-mentioned range. The annual inflation rate in 2016 represented 6.4 per cent, significantly lower than in 2015[8]. This trend was largely due to modest domestic demand, the high level of the base period in 2015, and a rich harvest that favored the decline in food prices. At the same time, the downward trajectory of inflation was also supported by a decrease in regulated price pressures as a result of lowering of the gas and electricity tariff in the first part of the year but also due to the gradual dissipation of the impact of tariff increase for the electricity in the summer of 2015. The evolution of the national currency compared to US dollar, as well as the upward trend in food and oil prices on the international market partially mitigated the disinflationary influence of the aforementioned factors.

1.5.3. National Currency Exchange Rate

The national currency (MDL – Moldovan Lei) has been put into circulation in November 1993. During 1994-2016, the average MDL exchange rate for the year (in nominal terms) registered a significant depreciation against United States Dollars (USD) (Table 1-15).

In 2016, the national currency exchange rate recorded 1.6 per cent depreciation in nominal terms against United States Dollars (from 19.6585 MDL for 1 USD, as of 01.01.2016 to 19.9814 MDL for 1 USD, as of 31.12.2016)[9]. The main drivers of the above changes in the exchange rate were: inflows of currency from abroad, US dollar fluctuation on the international monetary markets, foreign trade dynamics and the interventions of the National Bank of Moldova on the exchange market.

[7] <https://www.bnm.md/ro/content/raport-anual-2015>

[8] <https://www.bnm.md/ro/content/raport-anual-2016>

[9] <https://www.bnm.md/ro/content/ratele-de-schimb>

Table 1-14: Consumer Price Index for Goods and Services in the RM within 1993-2016 periods, %

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Inflation, average rate of consumption index increase, %	788.5	329.6	30.2	23.5	11.8	7.7	39.3	31.2	9.6	5.2	11.7	12.4
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Inflation, average rate of consumption index increase, %	11.9	12.7	12.4	12.7	0.0	7.4	7.7	4.6	4.6	5.1	9.7	6.4

Source: <http://www.indexmundi.com/moldova/inflation_rate_(consumer_prices).html>.

Table 1-15: The Average Annual Exchange Rate of the Republic of Moldova's National Currency (MDL) against United States Dollars (USD) in Nominal Terms, 1993-2016

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Exchange rate, MDL /US $	1.34	4.07	4.50	4.60	4.62	5.37	10.50	12.43	12.87	13.57	13.94	12.33
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Exchange rate, MDL /US $	12.60	13.13	12.14	10.39	11.11	12.37	11.74	12.11	12.59	14.04	18.82	19.92

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

As of 31.12.2016, the National Bank of Moldova owned foreign currency provisions, which totaled USD 2,205.93 billion, an increase by 449.12 million compared to 31.12.2015, when these represented USD 1,756.81 million. This increasing trend continued in 2017, reaching on August 30, 2017 to USD 2,508.38 million[10].

[10] <https://www.bnm.md/ro/content/informatie-privind-evolutia-activelor-oficiale-de-rezerva-luna-au-gust-2017>

1.5.4. Trade Balance Deficit

The RM's import expenses exceed considerably the nation's proceeds from its exports, thus indicating a severe problem in terms of the nation's trade balance deficit (Table 1-16). That deficit reached 23.7 per cent of the GDP in 2000 and over 29.3 per cent of the GDP in 2016.

Table 1-16: Trade Balance Deficit of the Republic of Moldova 1993-2016

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
GDP, billion US $	1.358	1.165	1.441	1.694	1.929	1.699	1.174	1.289	1.480	1.662	1.981	2.598
Exports (CIF), billion US $	0.483	0.565	0.746	0.795	0.874	0.632	0.463	0.471	0.565	0.644	0.790	0.985
% compared to the preceding year	102.8	117.1	131.9	106.6	109.9	72.3	73.3	101.7	119.9	113.8	122.7	124.7
Imports (FOB), billion US $	0.628	0.659	0.841	1.072	1.171	1.024	0.586	0.776	0.892	1.038	1.402	1.769
% compared to the preceding year	98.1	105.0	127.5	127.5	109.2	87.4	57.3	132.4	114.9	116.3	135.1	126.1
Trade balance deficit, billion US $	-0.145	-0.094	-0.095	-0.277	-0.297	-0.392	-0.123	-0.305	-0.327	-0.394	-0.612	-0.783
Coverage of IMP with EXP, %	76.9	85.8	88.7	74.1	74.6	61.7	79.0	60.7	63.4	62.0	56.3	55.7
% of GDP: exports	26.5	48.5	51.7	46.9	45.3	37.2	39.5	36.6	38.2	38.7	39.9	37.9
imports	34.5	56.6	58.3	63.3	60.7	60.3	50.0	60.2	60.3	62.4	70.8	68.1
balance	-8.0	-8.1	-6.6	-16.4	-15.4	-23.1	-10.5	-23.7	-22.1	-23.7	-30.9	-30.2
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP, billion US $	2.988	3.408	4.402	6.056	5.438	5.813	7.016	7.286	7.983	7.981	6.512	6.751
Exports (CIF), billion US $	1.091	1.050	1.340	1.591	1.283	1.542	2.217	2.162	2.428	2.340	1.967	2.045
% compared to the preceding year	110.7	96.3	127.6	118.7	80.6	120.1	143.8	97.5	112.3	96.3	84.1	104.0
Imports (FOB), billion US $	2.292	2.693	3.690	4.899	3.278	3.855	5.191	5.213	5.492	5.317	3.987	4.020
% compared to the preceding year	129.6	117.5	137.0	132.8	66.9	117.6	134.7	100.4	105.4	96.8	75.0	100.8
Trade balance deficit, billion US $	-1.201	-1.643	-2.350	-3.308	-1.995	-2.314	-2.974	-3.051	-3.064	-2.978	-2.020	-1.975
Coverage of IMP with EXP, %	47.6	39.0	36.3	32.5	39.1	40.0	42.7	41.5	44.2	44.0	49.3	50.9
% of GDP: exports	36.5	30.8	30.4	26.3	23.6	26.5	31.6	29.7	30.4	29.3	30.2	30.3
imports	76.7	79.0	83.8	80.9	60.3	66.3	74.0	71.6	68.8	66.6	61.2	59.6
balance	-40.2	-48.2	-53.4	-54.6	-36.7	-39.8	-42.4	-41.9	-38.4	-37.3	-31.0	-29.3

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

The above reflects the nation's dependence on the imports of energy resources and the growing demand for the imported products. The imports growth is driven by the massive inflow of cash transfers from abroad, which are channeled in domestic consumption.

The range of RM's exports is relatively narrow, thus complicating the nation's efforts to penetrate the western markets. Food and alcoholic drinks, textiles and textile articles, vegetable products, base metals and products thereof, machinery and mechanical appliances and electrical equipment prevail in the exports. In 2013, food and alcoholic drinks, textiles and textile articles accounted jointly with machinery, mechanical appliances and electrical equipment for 63.6 per cent of the total exports (Table 1-17).

The exports with the destination the European Union member states (UE–28) accounted for 1 332.4 mill. USD (by 9.4 per cent more compared to 2015), thus representing 65.1 per cent of the total (61.9 per cent – in 2015). The CIS countries accounted for 20.3 per cent (25.0 per cent – in 2015), thus representing 414.2 mill. USD. The exports toward these countries, decreased by 15.9 per cent, compared to 2015.

The top destination countries in 2016, compared to 2015 were represented by Romania (+14.9 per cent), Bulgaria (by 2.7 times), Germany (+8.0 per cent), Switzerland (+25.8 per cent), Iraq (+53.8 per cent), Malaysia (by 3.3 times), Poland (+7.2 per cent), Austria (+26.1 per cent), China (by 1.7 times), Israel (by 3.4 times), Portugal (by 14.9 times), Ukraine (+8.4 per cent), Greece +16.1 per cent), Hungary (by 2.1 times), Macedonia (by 2.6 times) and Myanmar (by 4.5 times), which favored the total export increase by 10.0 per cent. At the same, a decrease was recorded toward the following countries: Kazakhstan (-77.5 per cent), Belarus (-21.3 per cent), United Kingdom (-17.2 per cent), Russian Federation (-3.1 per cent), Indonesia (-66.6 per cent), USA (-22.8 per cent), Latvia (-49.8 per cent) and Cyprus (-46.7 per cent), thus reducing the total export increase by 6.4 per cent. The top 30 destination countries for RM's exports, which accounted for about 90 per cent of the total exports were: Romania (25.1 in 2016, respectively 22.7 per cent in 2015), Russian Federation (11.4 per cent and 12.2 per cent), Italy (9.7 and 10.0 per cent), Germany (6.2 and 6.0 per cent), United Kingdom (5.6 and 7.0 per cent), Belarus (5.1 and 6.7 per cent), Bulgaria (3.7 and 1.4 per cent), Poland (3.6 and 3.5 per cent), Turkey (3.0 and 3.3 per cent), Ukraine (2.4 and 2.3 per cent), Switzerland (2.2 and 1.8 per cent), France (2.2 and 2.2 per cent), Czech Republic (1.4 and 1.4 per cent), Greece (1.4 and 1.3 per cent), Austria (1.3 and 1.1 per cent), Netherlands (1.3 and 1.2 per cent), Iraq (1.3 and 0.9 per cent), Spain (0.9 and 0.9 per cent), USA (0.8 and 1.1 per cent), Georgia (0.8 and 0.9 per cent), China (0.7 and 0.4 per cent), Kazakhstan (0.6 and 3.0 per cent), Belgium (0.5 and 0.5 per cent), Hungary (0.5 and 0.2 per cent), Lebanon (0.5 and 0.4 per cent), Malaysia (0.5 and 0.2 per cent), Lithuania (0.4 and 0.4 per cent), Israel (0.4 and 0.1 per cent), Slovakia (0.3 and 0.5 per cent), Syria (0.3 and 0.3 per cent), etc.

In 2016, compared to 2015, an increase in exports was recorded for the following goods: cereals and cereal-based

Table 1-17: Structure of exports by group of goods within 2005-2016 periods in the RM, %

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total exports, including:	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Live animals and animal products	1.6	1.6	1.0	0.6	0.7	1.7	1.7	1.7	1.5	2.6	1.9	2.0
Vegetable products	**12.1**	**13.0**	**12.2**	**13.2**	**20.6**	**22.1**	**21.2**	**16.7**	**20.9**	**23.5**	**25.5**	**25.9**
Animal or vegetable fats and oils	3.5	3.3	4.1	4.0	3.9	3.1	3.5	4.1	1.8	3.3	3.7	2.7
Food, drinks and tobacco	**36.3**	**26.3**	**20.5**	**19.6**	**21.9**	**20.6**	**14.9**	**18.1**	**17.6**	**16.2**	**15.4**	**15.7**
Mineral products	1.8	2.6	4.3	4.0	1.1	1.1	1.7	1.5	1.7	1.2	0.9	0.7
Chemical products	1.4	2.0	2.0	2.1	4.5	4.8	5.0	6.7	6.9	7.2	6.1	4.4
Plastics, rubber and articles thereof	1.1	1.5	2.5	2.4	2.1	1.7	2.8	2.8	2.6	2.0	2.1	1.7
Raw hides and skins, leather, fur skins and articles thereof	6.6	2.2	2.2	2.1	1.9	1.6	1.6	1.4	1.4	1.5	1.3	1.2
Wood and articles of wood (excluding furniture)	0.2	0.4	0.3	0.3	0.3	0.4	0.5	0.6	0.4	0.3	0.4	0.5
Paper, paper-board and articles thereof	1.1	1.7	2.0	1.1	0.6	0.8	1.1	0.9	1.1	0.8	0.5	0.6
Textiles and textile articles	**17.8**	**21.7**	**20.6**	**19.7**	**20.1**	**17.4**	**16.0**	**15.9**	**13.6**	**14.1**	**13.9**	**15.0**
Footwear, headgear, umbrellas and similar articles	2.4	2.9	3.0	3.0	2.1	2.0	2.3	1.9	1.5	1.4	1.2	1.4
Articles of stone, gypsum, cement, ceramic, glass or similar materials	1.7	3.1	3.8	3.3	2.0	2.3	2.1	1.8	2.4	2.5	2.1	2.2
Base metals and articles of base metals	4.5	7.2	8.3	7.5	2.3	3.8	5.1	3.4	5.1	2.4	2.2	2.1
Machinery and mechanical appliances, electrical equipment	**4.2**	**5.1**	**6.8**	**10.5**	**10.8**	**11.1**	**12.8**	**12.9**	**13.0**	**13.2**	**15.0**	**14.6**
Vehicles and associated transport equipment	1.4	1.6	1.4	1.0	1.2	1.4	2.1	3.0	1.9	1.2	0.9	1.3
Instruments and apparatus	0.7	1.2	1.7	1.8	0.9	0.8	1.0	1.5	1.7	1.5	1.4	1.4
Miscellaneous manufactured articles	1.6	2.6	3.3	3.8	3.0	3.3	4.4	5.0	4.9	5.0	5.5	6.6

Source: National Bureau of Statistics. Statistical database (<http://www.statistica.md/category.php?l=ro&idc=336&>).

products (+34.0 per cent), seeds and oleaginous fruits (+13.6 per cent), wood furniture and wood parts (+25.1 per cent), textiles and textile articles (+41.6 per cent), clothing and accessories (+6.7 per cent), road vehicles (by 2.3 times), machinery and electrical equipment (+5.7 per cent), organic chemical products (by 2.9 times), metal products (+36.3 per cent), footwear (+21.7 per cent), alcoholic and nonalcoholic drinks (+2.2 per cent), sugar, sugar-based products, honey (+9.9 per cent), dairy products and chicken eggs (+29.4 per cent), which contributed to an increase of 9.9 per cent on total exports. At the same time, exports decreased for vegetables and fruits (-8.8 per cent), medicinal and pharmaceutical products (-35.6 per cent), fixed, crude, refined or fractionated vegetable fats and oils (-24.8 per cent), machinery and industrial general appliances (-21.5 per cent), metal minerals and metal waste (-39.3 per cent), essential oils, resinoids and fragrances, toiletries, beauty products (-9.0 per cent), petroleum, petroleum products and related products (-33.0 per cent), power generating machines and their equipment (-60.5 per cent), textile fibers (-79.5 per cent), thus reducing the total export increase by 6.2 per cent.

1.5.5. Cash Transfers and Remittances

Cash transfers from outside the country, and in particular cash inflows from the Moldovans working abroad are of major importance for the economy of the RM. Globally, the country is among the leaders regarding the share of remittances into the GDP. In 2016, the total net inflow of foreign currency from the Moldovans working abroad accounted for USD 1.4649 billion or circa 21.7 per cent of the GDP (Table 1-18).

Notwithstanding the trade balance deficit for products and services increasingly higher cash inflows from the Moldovans employed outside the country have contributed to the decrease of the current account deficit of the RM. The country's evident dependence on cash transfers from its citizens employed abroad presents a potential threat and indicates the lack of sustainability because the inflow of funds from outside the country creates incentives to increase consumption rather than production, thus leading to growth of imports and inflation, and a direct negative economic shock may ensure, should the volume of such transfers decrease rapidly. In recent years the flows of money transferred from

Table 1-18: Remittances from Moldovans Working Abroad within 1997-2016 periods

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
GDP, million US $	1 928.7	1 699.0	1 173.5	1 288.8	1 480.3	1 662.3	1 981.3	2 597.9	2 988.2	3 408.1
Remittances, million US $	114.4	124.3	111.9	177.6	242.2	322.6	484.0	701.4	915.1	1 175.8
% compared to the preceding year	131.2	108.7	90.0	158.8	136.4	133.2	150.0	144.9	130.5	128.5
% of the GDP	5.9	7.3	9.5	13.8	16.4	19.4	24.4	27.0	30.6	34.5
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
GDP, million US $	4 402.5	6 056.3	5 437.6	5 813.0	7 016.2	7 285.5	7 982.9	7 980.7	6 512.4	6 750.8
Remittances, million US $	1 491.3	1 888.0	1 352.4	1 752.8	1 813.1	1 986.4	2 191.5	2 075.9	1 540.1	1 464.9
% compared to the preceding year	126.8	126.6	71.6	129.6	103.4	109.6	110.3	94.7	74.2	95.1
% of the GDP	33.9	31.2	24.9	30.2	25.8	27.3	27.5	26.0	23.6	21.7

Source: World Bank, 2017 (<https://data.worldbank.org/indicator/BX.TRF.PWKR.CD.DT?end=2016&start=1990>).

abroad tend to decrease, as some of the immigrants settle for permanent residence in other countries.

1.5.6. Investments, International Investment Position and Gross External Debt

Investments are of major importance for the growth of the RM's economy. In recent years, investments registered a significant increase as compared to the preceding years' levels. In 2016, the investments attracted by the national economy represented about 19.406 billion MDL, equivalent to about USD 0.974 billion (14.4 per cent of the GDP) (Table 1-19).

At the same time, in 2016, the direct net foreign investments (DFI) attracted to the national economy represented USD 124.4 million (1.8 per cent of the GDP), much less compared to 2008, when these accounted for USD 726.6 million (12.0 per cent of the GDP) (Table 1-20). Net DFI inflows in 2016 continued the decreasing trend, recording the smallest value in the recent ten years (124.4 mill. USD, a decrease by 46.9 per cent compared to 2015). The decrease was driven partially by the unfavorable international context (according to UNCTAD data, the global DFI flows decreased in 2016 by 13 per cent due to weak global economic growth), but also the internal conditions were among the reasons the foreign investors maintained their reticence[11].

The international investment position of the country, as of 31.12.2016, remained net debtor and accounted -5.979 billion USD, with the negative balance increasing towards the end of 2015 by 7.0 per cent: the foreign assets, representing 3.389 billion USD, decreasing by 1.4 per cent, while the liabilities – 9.368 billion USD, increasing by 3.8 per cent. These changes determined the deterioration by 1.9 percentage points of the ratio between the stock of assets and foreign liabilities, from 36.2 per cent at 31.12.2016. The stock of liabilities to foreign direct investments represented 3.581 billion USD (an increase by 3.3 per cent from the beginning of the year) and accounted for 38.2 per cent of the total. During 2016, the stock of official reserve assets was reassured, thus, as from 31.12.2016, this stock exceeded the level recorded at the end of 2014, increasing by 25.6 per cent compared to the end of 2015 and accounting for 2.206 billion USD. The country's gross external debt as of December 31, 2016 recorded 6.595 billion USD, increasing over the year 2016 by 3.3 per cent. Public debt as well as the publicly guaranteed debt represented 27.0 per cent of the total debt, totaling 1.779 billion USD, increasing from the beginning of the year by 4.5 per cent. Unsecured private debt amounted to 4.816 billion USD, an increase by 2.9 per cent from the end of the previous year. The largest share of gross external debt stock is represented by the long-term debt (74.4 per cent). The share of creditors, international organizations and foreign governments in the external debt stock of the RM in the form of loans and allocation of special drawing rights (SDR) represented 43.5 per cent.

1.5.7. Social Sphere

In 2016, the average gross nominal salary of an employee in the national economy (real sector units with 4 and more employees and all budgetary institutions, irrespective of the number of employees) represented 5084.0 MDL, an increase by 10.3 per cent in nominal value compared to 2015 (Table 1-21), and by 3.7 per cent in real terms (adjusted to the consumer price index).

In December 2016, the average monthly salary was 6003.7 MDL, a 14.8 per cent increase compared to December 2013 and by 15.4 per cent higher than in November 2016. The real salary index for December 2014 represented 112.1 per cent compared to the same period of the previous year (calculated as the ratio between the gross nominal salary and the consumer price index) or an increase by 12.1 per cent. In the public sector, in December 2015, the average monthly salary was 4492.6 MDL (+8.0 per cent compared to December 2015), in the economic (real) sector – 6648.3 MDL (+17.0 per cent compared to December 2015).

[11] <https://www.bnm.md/ro/content/conturile-internationale-ale-republicii-moldova-pentru-anul-2016-date-provizorii>

Table 1-19: Investments in the National Economy of the Republic of Moldova within 1993-2016

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Investments, billion MDL	0.171	0.712	0.845	0.987	1.202	1.444	1.592	1.759	2.315	2.804	3.622	5.140
Investments, billion US $	0.128	0.175	0.188	0.215	0.260	0.269	0.152	0.142	0.180	0.207	0.260	0.417
% of the GDP	9.4	15.0	13.0	12.7	13.5	15.8	12.9	11.0	12.2	12.4	13.1	16.0
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Investments, billion MDL	7.797	11.012	15.336	18.225	11.124	13.805	16.450	17.154	19.132	21.159	21.123	19.406
Investments, billion US $	0.619	0.839	1.264	1.754	1.001	1.116	1.402	1.417	1.520	1.507	1.122	0.974
% of the GDP	20.7	24.6	28.7	29.0	18.4	19.2	20.0	19.4	19.0	18.9	17.2	14.4

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

Table 1-20: Direct Net Foreign Investments attracted to the National Economy within 1993-2016

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
GDP, million US $	1358.3	1164.8	1441.4	1694.3	1928.7	1699.0	1173.5	1288.8	1480.3	1662.3	1981.3	2597.9
DFI, million US $	14.0	11.6	25.9	23.7	78.7	75.5	37.9	127.5	54.5	84.1	73.8	87.7
% compared to the previous year	82.4	82.6	224.0	91.6	331.7	95.9	50.2	336.6	42.8	154.1	87.7	118.9
% of the GDP	1.0	1.0	1.8	1.4	4.1	4.4	3.2	9.9	3.7	5.1	3.7	3.4
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
GDP, million US $	2988.2	3408.1	4402.5	6056.3	5437.6	5813.0	7016.2	7285.5	7982.9	7980.7	6512.4	6750.8
DFI, million US $	190.7	258.7	536.0	726.6	135.2	212.0	347.9	282.6	290.5	349.9	234.4	124.4
% compared to the previous year	217.5	135.6	207.2	135.6	18.6	156.9	164.1	81.2	102.8	120.5	67.0	53.1
% of the GDP	6.4	7.6	12.2	12.0	2.5	3.6	5.0	3.9	3.6	4.4	3.6	1.8

Source: World Bank <https://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD?end=2016&start=1993>.

Table 1-21: Average Monthly Salary and Average Monthly Old Age Pension 1993-2016

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Nominal salary, MDL	31.2	108.4	143.2	187.1	219.8	250.4	304.6	407.9	543.7	691.5	890.8	1103.1
Nominal salary growth, %	897.3	347.4	132.1	130.7	117.5	113.9	121.6	133.9	133.3	127.2	128.8	123.8
Real salary growth, %	69.9	59.2	101.6	105.4	104.9	105.5	87.3	102.1	121.6	120.9	115.4	110.2
Nominal salary, US $	23.3	26.7	31.9	40.7	47.5	46.6	29.0	32.8	42.2	51.0	63.9	89.5
Real salary growth, %		114.5	119.5	127.6	116.9	98.1	62.2	113.1	128.7	120.6	125.4	140.0
Nominal salary, US $ (CPI)	185.6	250.5	167.7	183.8	198.8	209.2	183.3	195.7	238.4	281.3	322.1	251.7
Real salary growth (%)		135.0	66.9	109.6	108.2	105.3	87.6	106.8	121.8	118.0	114.5	78.1
Old age pension, MDL	18.8	55.2	64.3	78.7	82.8	83.9	82.8	85.1	135.8	161.0	210.5	325.3
Old age pension, US $	14.0	12.9	14.3	16.7	17.6	10.1	7.1	6.9	10.4	11.6	15.9	26.1
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Nominal salary, MDL	1318.7	1697.1	2065.0	2529.7	2748.4	2972.2	3193.9	3477.7	3765.1	4172.0	4610.9	5084.0
Nominal salary growth, %	119.5	128.7	121.7	122.5	108.6	108.1	111.6	108.9	108.3	110.8	110.5	110.3
Real salary growth, %	106.8	114.2	108.4	108.7	108.6	100.7	103.8	104.1	103.5	105.4	100.7	103.6
Nominal salary, US $	104.7	129.2	170.2	243.5	247.3	240.3	272.1	287.2	299.0	297.2	245.0	255.2
Real salary growth, %	117.0	123.5	131.7	143.1	101.6	97.2	113.2	105.5	104.1	99.4	82.4	104.2
Nominal salary, US $ (CPI)	297.4	348.4	376.4	431.6	463.2	456.7	577.0	592.7	622.3	546.0	548.6	566.2
Real salary growth (%)	118.2	117.2	108.0	114.7	107.3	98.6	126.3	102.7	105.0	87.8	100.5	103.2
Old age pension, MDL	383.4	442.3	548.3	646.4	775.5	810.9	873.9	957.6	1020.6	1087.6	1165.2	1275.2
Old age pension, US $	30.4	33.7	45.2	62.2	69.8	65.6	74.5	79.1	81.1	77.5	61.9	64.0

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

According to preliminary data provided by the National Office of Social Insurance, the number of pensioners registered by the social security authorities as of January 1, 2017 represented 691.2 thousand people, with 11.3 thousand more compared to January 1, 2016. As of January 1, 2017, the average monthly old-age pension was 1275.2 MDL, increasing by 9.4 per cent compared to its level as of January 1, 2016. In the total structure of pensioners, the largest share is represented by pensioners following an age limit – 76.9 per cent, followed by pensioners with disabilities and survivorship pensions, respectively with 19.2 per cent and 2.1 per cent. Over 56 thousand people benefit from social allowances, the largest category of beneficiaries being persons with disabilities from childhood (47.3 per cent). As of January 1, 2017, 79.3 thousand people benefited from childcare allowances, of which 55.9 per cent were insured. The average monthly allowance for insured people represented 1234.3 MDL, while for uninsured ones – 540 MDL.

The 2016 unemployment, estimated according to the standards of the International Labor Organization (ILO), was 53.3 thousand people (Table 1-22).

The unemployment rate (unemployed persons as a percentage of the total economically active population) recorded at the country level represents 4.2 per cent -5.5 per cent for males and 2.9 per cent for females. There still are significant differences between the unemployment rate in urban areas (6.0 per cent) and the rural areas (2.6 per cent). According to data provided by the National Employment Agency, as of January 1, 2017, 26.9 thousand registered unemployed were looking for a job, while the business units dismissed every 16th. Of the total number of unemployed, 47 per cent are females. Only 8 per cent of the registered unemployed receive unemployment allowance; in December 2016, the average unemployment allowance represented 1356.8 MDL. On average, the rate was 4 unemployed persons per one job.

1.6. Current State of National Economy

1.6.1. Industrial Production

The 2016 industrial production reached approximately 40.1 billion MDL (in current prices). Compared to the 2016 level, the industrial production level index increased by 0.9 per cent (under comparable conditions) (Table 1-23, Figure 1-10).

Table 1-22: Economically Active Population, Number of Employees, Unemployed and Unemployment Rate in the Republic of Moldova, 2005-2016

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Economically active population, thousand people	1422.3	1357.2	1313.9	1302.8	1265.3	1235.4	1257.5	1214.5	1235.8	1232.4	1265.6	1272.8
Employees, thousand people	1318.7	1257.3	1247.2	1251.0	1184.4	1143.4	1173.5	1146.8	1172.8	1184.9	1203.6	1219.5
Number of unemployed, thousand people	103.7	99.9	66.7	51.7	81.0	92.0	84.0	67.7	63.1	47.5	62.1	53.3
Males	59.8	61.7	41.5	30.0	50.8	57.3	49.6	42.2	38.0	28.9	39.3	35.0
Females	43.9	38.2	25.2	21.8	30.2	34.7	34.4	25.6	25.1	18.6	22.7	18.3
Urban	72.5	56.8	40.7	32.7	47.5	57.4	50.0	43.6	36.8	29.4	38.3	35.7
Rural	31.2	43.1	25.9	19.1	33.5	34.6	34.1	24.2	26.3	18.1	23.8	17.6
Unemployment rate, %	7.3	7.4	5.1	4.0	6.4	7.4	6.7	5.6	5.1	3.9	4.9	4.2
Males	8.7	8.9	6.3	4.6	7.8	9.1	7.7	6.8	6.0	4.6	6.2	5.5
Females	6.0	5.7	3.9	3.4	4.9	5.7	5.6	4.3	4.1	3.1	3.6	2.9
Urban	11.2	9.2	6.9	5.5	8.0	9.6	8.2	7.3	6.3	5.2	6.4	6.0
Rural	4.0	5.8	3.6	2.7	5.0	5.4	5.2	3.9	4.1	2.7	3.5	2.6

Source: Statistical Data Bank of the National Bureau of Statistics: <http://statbank.statistica.md/pxweb/pxweb/ro/30%20Statistica%20sociala/30%20Statistica%20sociala__03%20FM__03%20MUN__MUN060/MUN060200.px/table/tableViewLayout1/?rxid=2345d98a-890b-4459-bb1f-9b565f99b3b9>.

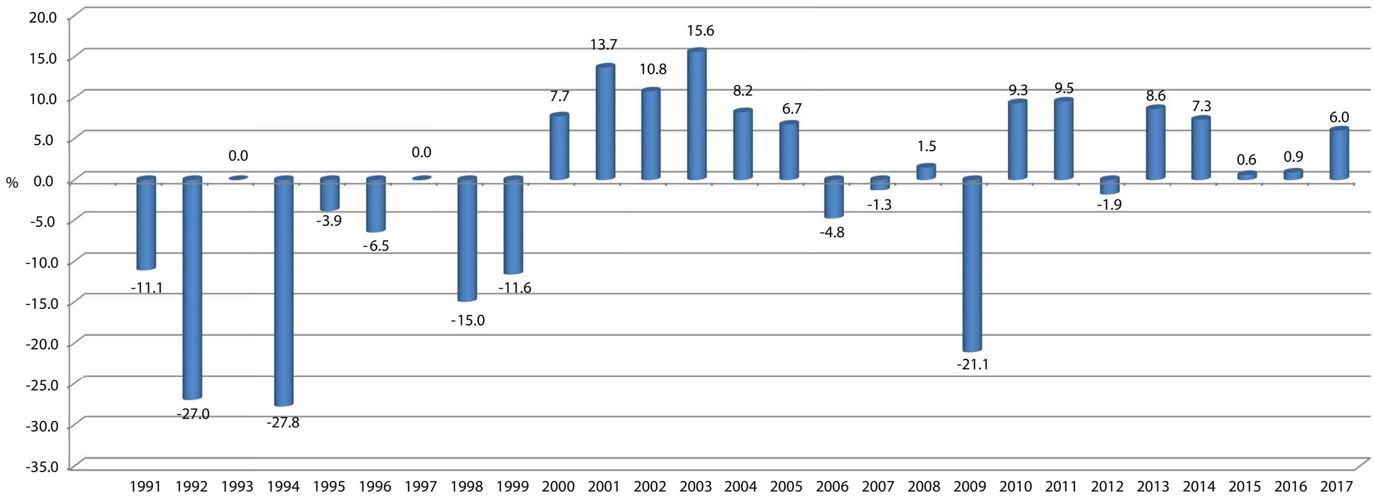


Figure 1-10: Evolution of Industry Sector in the Republic of Moldova, 1991-2017, in % compared to the previous year.

Table 1-23: Evolution of Industry Sector in the Republic of Moldova, 1990-2017

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Industry, billion MDL	11.5	22.2	129.8	1.2	3.7	4.3	4.7	5.9	6.0	7.2	8.2	10.4	12.6	16.0
in % compared to the previous year		-11.1	-27.0	0.0	-27.8	-3.9	-6.5	0.0	-15.0	-11.6	7.7	13.7	10.8	15.6
in % compared to 1990		88.9	64.9	64.9	46.9	45.0	42.1	42.1	35.8	31.6	34.1	38.7	42.9	49.6
Industry, billion US $				0.885	0.921	0.949	1.019	1.274	1.114	0.685	0.657	0.810	0.930	1.145
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Industry, billion MDL	17.6	20.8	22.4	26.2	30.0	22.6	28.1	34.2	36.4	39.4	43.5	45.7	48.1	52.0
in % compared to the previous year	8.2	6.7	-4.8	-1.3	1.5	-21.1	9.3	9.5	-1.9	8.6	7.3	0.6	0.9	6.0
in % compared to 1990	53.7	57.3	54.5	53.8	54.6	43.1	47.1	51.6	50.6	55.0	59.0	59.3	59.9	63.4
Industry, billion US $	1.427	1.648	1.704	2.157	2.886	2.038	2.276	2.913	3.003	3.130	3.102	2.426	2.417	2.602

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

During 1990-2017, the industrial sector featured certain fluctuations, showing the best performance in 2001 and 2003 and the worst performance in 1992, 1994, 1998, 1999 and 2009.

Processing Industry. The situation in the Industry Sector was determined mainly by the processing industry, which accounted in 2014 for 87.6 per cent of the total production of the large enterprises whose main business was manufacturing. The production of those enterprises increased by 1.8 per cent compared to 2015.

Food and drinks industry accounted for the highest share in the processing industry performance (Table 1-24).

Table 1-24: Production of Main Industrial Products by RM's Manufacturing Industry, 2005-2016

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Meat, kt	5.9	9.0	14.3	12.1	15.3	23.7	27.8	31.0	34.5	43.1	44.6	44.2
poultry, kt	2.3	4.8	5.8	7.6	10.4	12.5	14.0	16.7	21.3	26.6	28.5	29.6
Sausages, kt	14.2	14.6	17.0	18.9	14.1	13.2	14.5	15.9	17.2	16.3	17.2	16.4
Canned meat, kt	0.6	1.0	1.1	1.3	1.0	1.5	1.3	1.5	0.9	0.7	0.5	0.5
Fruit and vegetable juices, kt	25625	27721	47995	32196	23215	27115	29715	46055	49059	49075	39243	49687
Unconcentrated juices	7171	18398	26921	16959	11467	17461	16828	21099	22826	21483	21535	18755
concentrated juices	14642	9324	21074	15237	11747	9654	12887	24956	26234	27592	17708	30932
Canned fruits and vegetables, kt	33.0	44.4	22.7	41.9	26.5	29.9	26.3	24.3	25.1	30.4	15.7	16.7
..Processed and canned fruits, kt	18.3	17.3	16.5	17.8	3.7	8.0	6.8	4.7	10.7	7.6	7.9	9.4
Crude oil, kt	83.2	81.2	84.7	79.2	83.7	80.7	89.7	93.5	53.9	109.6	109.5	79.9
Margarine, t	3390	2624	2225	1944	1658	1274	1119	788	706	..	..	..
Milk and cream with fat content <6%, kt	20.8	50.3	55.3	66.6	61.4	65.1	62.9	62.4	65.3	78.7	80.0	86.0
Solid milk and cream, t	4565	3806	2676	2693	1821	1217	625	536	439	1042	1357	1675
Butter, tons	3393	3321	3387	4338	3819	4199	3878	3764	4159	4673	4787	5869
Fat cheese and young sheep cheese, t	2380	2008	2035	2519	1309	1779	2087	2113	2435	2427	2469	2402
Curd, curd cream, yogurt, kefir, sour cream and other fermented products, t	21032	21378	23851	23934	24464	25615	27314	29144	30216	31542	32659	32744
Ice-cream and other ice-forms with or without cocoa, t	12225	13258	12646	11477	10671	12491	12375	14064	15160	15633	15969	16473
Flour, kt	144.0	133.5	113.3	122.6	115.6	108.0	118.2	101.9	117.9	118.4	113.2	103.8
Cereals, kt	3.0	4.3	4.7	6.4	7.2	5.6	4.8	3.6	4.4	4.7	5.7	5.3
Ready-made forage for animals, kt	48.8	60.6	42.9	49.1	56.8	71.6	73.3	94.9	96.3	97.3	79.0	95.4
Bread and bakery foods, kt	108.4	112.3	122.8	137.5	130.6	129.0	130.0	129.3	132.5	128.4	131.5	129.2

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
..Fresh bread	105.7	108.8	119.4	133.7	126.7	124.3	125.9	124.8	126.8	122.3	124.4	121.2
..Other bakery products	2.7	3.5	3.4	3.8	3.9	4.8	4.2	4.5	5.7	6.1	7.1	8.0
Flour confectionary, kt	19.8	20.8	21.4	22.0	22.9	26.9	28.3	30.6	33.9	34.0	33.6	34.4
Sugar, kt	133.5	149.0	74.0	134.0	38.4	103.2	88.4	83.4	140.3	177.7	84.5	100.0
Molasses, kt	42.2	42.3	24.9	34.5	23.3	36.2	35.8	31.7	53.1	61.1	30.6	39.1
Sugar confectionery, kt	12.3	12.2	13.2	13.8	12.6	12.9	13.0	12.3	13.4	13.7	14.0	14.2
Macaroni, kt	7.8	7.2	6.9	5.7	6.1	6.3	6.5	5.6	6.3	5.6	5.7	5.0
Mayonnaise and other emulsified sauces, tons	2578	2141	1768	1066	827	540	466	476	486	549	509	607
Cognac (Divine), thousand dal	4781	2245	2022	2815	1785	1766	2395	3084	3451	2762	2186	1433
Vodka, thousand dal	4906	2625	2020	1418	1059	1290	1967	2601	3380	3264	2737	2632
Brandy and liqueurs, thousand dal	8133	6214	4627	3099	2433	2662	2719	3025	3896	3673	3103	3075
Sparkling wine, thousand dal	1051	402	541	572	500	556	686	654	596	514	502	629
Natural grape wine, mill. dal	36.3	19.3	12.3	15.4	12.5	12.7	12.5	14.1	15.3	13.9	13.4	13.3
Porto, Madeira, Sherry, Tokay wine and other, thou dal	3238	1337	753	922	693	1051	1112	528	651	348	371	470
Mineral and carbonated waters, mill. dal	9.6	10.6	12.9	12.3	11.1	11.6	10.8	10.7	9.5	10.8	11.9	12.6
Soft beverages, mill. dal	6.4	7.5	9.4	7.7	6.0	6.5	7.2	7.2	6.4	6.4	6.5	4.6
Fermented tobacco, kt	8.2	5.2	4.3	6.3	4.9	7.3	6.8	5.7	3.5	2.6	1.7	1.1
Fabrics, thousand m^2	116.0	107.0	201.0	174.0	111.0	55.0	20.0	10.0	13.0	-	-	-
Hosiery, thousand pairs	1082	1518	1428	1558	1463	1288	1470	1607	1056	1573	2046	1979.2
Knitwear, mln. pcs	17.0	16.5	16.9	19.3	17.6	20.2	17.2	18.6	18.2	16.9	15.2	16.6
Clothing for work, thousand pcs	3848	4528	5660	5581	4034	6191	6554	4791	3971	3684	4067	4368
Overcoats, raincoats, capes, cloaks, anoraks, thou pcs	938	860	939	791	776	650	616	524	694	758	730	840
Suits and assemblies, thousand pcs	344	215	435	270	127	98	136	102	95	81	60	72
Coats, jackets and blazers, thousand pcs	514	709	509	601	565	458	503	579	534	698	658	477
Trousers, shorts and overalls, thousand pcs	2452	2841	2258	1651	1530	1776	1613	1286	1188	1294	1120	1407
Dresses and sarafans, thousand pcs	121	343	671	1013	735	799	1034	1898	1372	1182	1125	1072
Skirts and divided skirts, thousand pcs	733	636	526	367	377	250	336	379	1307	635	530	472
Blouses and shirts for women and girls, thou pcs	1984	2549	1824	1939	1920	1916	1835	3310	2451	2060	2170	2507
Coffers, suitcases, trunks and similar containers of any material, thousand pcs	317	312	279	340	138	129	137	135	107	110	83	49
Bags for women of any material, thousand pcs	99	80	101	155	117	95	131	107	134	169	136	151
Footwear, thousand pairs	3650	3673	3796	3832	2221	2717	2849	3053	2942	2866	1886	2078
Saw-timber, thousand cubic meters	21.7	25.9	29.3	45.3	32.9	24.8	17.4	18.4	15.7	14.9	15.9	13.6
Wooden blocks for doors and windows, thousand m^2	16.4	18.9	21.4	16.4	22.8	19.1	14.1	13.7	12.5	15.2	11.8	10.1
Wooden block parquet, thousand m^2	98.4	119.1	104.4	60.5	37.0	26.3	23.6	15.3	19.7	14.7	10.6	20.0
Paper and corrugated paper-board, mill m^2	52.3	35.2	30.1	36.2	32.5	35.7	29.3	27.8	-	-	-	-
Paper and corrugated paper-board, kt	-	-	-	-	-	-	-	-	14.1	11.8	11.7	12.0
Printing services for newspapers and periodicals, appearing at least four times/week, mill. copies	558	553	750	596	423	723	709	981	727	899	706	1445
Printing services for newspapers and periodicals, appearing at least four times/week, t	1454	1496	1460	1417	1141	1789	1997	663	540	590	461	327
Copybooks, t	3198	3227	2599	2346	1691	1306	1385	503	..	..	..	..
Oxygen, thousand m^3	6269	8295	10815	11557	11822	12864	18011	17907	12345	17685	26858	32747
Carbon dioxide, t	317	526	562	399	380	538	523	570	637	787	993	995
Paints and varnishes, t	533	769	1034	451	482	618	727	798	1892	1416	1760	2821
Soap, t	62.5	66.9	41.5	72.4	46.0	67.9	50.9	13.1	50.3	47.2	42.4	45.5
Washing and cleaning products, t	714	2339	2135	1553	1578	1679	2048	2156	1989	2325	2749	2878
Natural essential oil, t	945	1219	668	555	470	298	160	193	214	182	159	151
Plastic tubes and pipes, t	31.4	85.2	79.7	246.7	186.0	339.6	352.1	389.9	449.5	531.7	476.8	403.3
Boxes, cases, crates and similar plastic products, t	9.8	11.0	12.9	12.5	11.3	10.8	11.7	19.5	-	-	-	-
Multiple-walled insulating glass, thousand m2	-	-	-	-	-	-	-	-	12.6	8.6	13.5	8.2
Glass mirrors, thousand m^2	355	321	303	285	201	246	326	223	273	244	229	219
Glass mirrors, thousand pcs.	114	109	118	108	80	77	85	59	74	74	78	72
Glass Bottles and vials, mill. pcs	132	188	331	380	136	142	159	188	162	172	195	204
Ceramic building bricks for construction, thousand m^3	231	233	224	223	177	202	184	221	207	241	289	277
Dry gypsum mixtures, kt	2214	1914	1878	1294	784	875	1009	953	898	902	675	651
Prefabricated structural components from cement, concrete or artificial stone for constructions, kt	173	222	125	109	31	59	73	77	85	46	70	36
Grey iron castings, tons	7.8	8.0	7.6	7.6	5.7	6.1	11.8	11.5	13.8	6.8	10.3	..
Steel castings, tons	1718	2525	4168	3967	3463	3110	4943	3687	4047	5414	4012	4614
Light non-ferrous metal castings, tons	36806	29758	21382	31926	53675	64636	62709	61126	35382	41309	25717	21736

Source: National Bureau of Statistics, <http://statbank.statistica.md/pxweb/pxweb/ro/40%20Statistica%20economica/40%20Statistica%20economica__14%20IND__IND030/IND030100.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>.

In 2016, compared to 2015, food industry reported an increase of production by 1.0 per cent. The increase in overall food production was driven by increases in: fish, crustaceans and mollusks processing and canning – by 48.2 per cent; dairy products – by 6.1 per cent; cocoa, chocolate and sugar confectionary manufacture – by 5.5 per cent; meat and meat products production, processing and canning – by 3.0 per cent; bread and fresh confectionary manufacturing – by 2.6 per cent etc.

At the same time, a decreasing trend was registered in some other processing sectors, such as: production of soft beverages; mineral and carbonated water production – by 35.5 per cent; vegetable and animal oils and fats production – by 14.9 per cent; fruit and vegetable processing and canning – by 11.0 per cent; distillation, refining and mixing of alcoholic beverages – by 2.2 per cent etc.

The increase in overall industrial production was driven by increases in other manufacturing sectors such as: wood and wood products processing excluding furniture; articles of straw and planting materials manufacture – by 50.2 per cent; textiles – by 31.8 per cent; furniture manufacture – by 27.5 per cent; paper and paper products – by 21.7 per cent; chemical industry – by 17.2 per cent; clothing manufacturing – 15.1 per cent; footwear manufacturing – by 14.8 per cent; metal industry, exclusively machinery, apparatus and installations – by 3.9 per cent, etc.

At the same time, a decreasing trend was registered in some other manufacturing sectors, such as: electrical equipment – by 17.4 per cent; metal industry – by 10.6 per cent; nonmetal mineral products– by 9.0 per cent; manufacture of tobacco products – by 8.5 per cent; computer, electronic and optical products manufacture – by 7.6 per cent; manufacture of rubber and plastic products – by 5.5 per cent; manufacture of basic pharmaceutical products and pharmaceutical drugs – by 1.3 per cent etc.

Energy Industry. In 2016, the energy sector enterprises accounted for circa 10.9 per cent of the total production of the large enterprises where industrial manufacture was the main business. These enterprises generated the sales of circa 4.4058 billion MDL (in current prices), decreasing by 1.0 per cent compared to 2015. The decrease was mostly generated by decrease in electricity generation, transport and distribution by 1.8 per cent. At the same time, an increase was recorded within the steam and air conditioning supply – by 2.3 per cent.

Brief Description of the Energy System of the Republic of Moldova

In the Republic of Moldova, power generating capacity includes: MTPP from Dnestrovsk (on the left bank of the Dniester) with an installed capacity of 2520 MW, operating on natural gas, residual fuel oil and coal, built between 1964-1982; CHP-2 Chisinau, with an installed capacity of 240 MW (available 210 MW) and 1200 Gcal/heat capacity, built between 1976-1980; CHP-1 Chisinau, with an installed capacity of 66 MW (available 40 MW) and 254 Gcal/heat capacity, built between 1951-1961; CHP-North Balti, with an installed capacity of 28.5 MW (available 24 MW) and 200 Gcal/heat capacity built in during 1956-1970; HPP Dubasari on the river Dniester with an installed capacity of 48 MW (30 MW available), 75 per cent overused degree, built between 1954-1966; HPP Costesti on the river Prut, with an installed capacity of 16 MW (10 MW available), 67 per cent overused degree, built in 1978; other power plants, including nine CHP owned by sugar plants with an installed capacity of 97.5 MW operating on natural gas and residual fuel oil, built during 1956-1981.

Of relatively high total nominal capacity (2996.5 MW) it can be used only about 346 MW in cogeneration regime in Chisinau and Balti and in the hydro base, respectively, it is used only about half of the MTPP capacity (in particular, due to difficult trading conditions). Most (stabilized at around 75-78 per cent during 2007-2015) of the electricity consumption of the country is covered by MTPP and imports from Ukraine.

It should be noted, however that between 1990-2015 electricity generation registered a decrease of 61.4 per cent, while electricity consumption decreased by 52.3 per cent (Table 1-25).

The power transmission system operator Moldelectrica SE manages the internal transport network on the right bank of the Dniester River, including 5,977.5 km transmission lines of 400, 330, 110 kV, and 25,877.4 km radial lines of 35 and 6-10 kV. Interconnections include 7 lines of 330 kV and 11 lines of 110 kV with Ukraine, 3 lines of 110 kV with Romania and 1 line of 400 kV with Romania and from there, with Bulgaria.

In 2000, the Republic of Moldova privatized a large part of the distribution sector (approximately 70 per cent), that including three of the five power distribution units, which, subsequently, merged in the RED "Union Fenosa" J.S.C[12], while the other two remained state-owned enterprises: J.S.C "RED North" and "RED North-West" J.S.C. On the left bank of the Dniester River the service is provided by "RED East" J.S.C. and "RED South-East".

Public Electricity Generation

The energy system of the Republic of Moldova owns only one condensation Thermal Power Plant (TPP) situated in Dnestrovsk, on the left bank of the Dniester. The TPP is

[12] Beginning with January 1, 2015, J.S.C. „Red Union Fenosa" legally separates the activity of electricity distribution from the electricity supply at regulated tariffs. This legal provision is stipulated in particular in art. 54 (5) of the Law on Electricity No. 124-XVIII dated 23.12.2009. As a result, the electricity supply at regulated tariffs is now ensured by the new enterprise J.S.C „Gas Natural Fenosa Electricity Supply", which is the legal successor of J.S.C. „Red Union Fenosa" (<http://www.gasnaturalfenosa.md/page/despre-noi>)

Table 1-25: Electricity Generation and Consumption within the National Economy within 1990-2015, billion kWh

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Electricity Generation	15.690	13.154	11.248	10.376	8.308	6.168	6.240	5.375	4.841	4.110	3.624	4.913	4.408
Electricity Consumption	11.426	10.839	10.022	8.569	7.306	7.022	6.686	6.133	5.351	4.715	4.510	4.705	5.309
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Electricity Generation	4.062	4.179	4.225	2.867	3.869	4.026	6.195	6.115	5.785	5.802	4.491	5.380	6.050
Electricity Consumption	6.452	6.025	5.838	5.485	5.684	5.732	5.302	5.257	5.416	5.604	5.449	5.456	5.455

Source: Statistical Yearbooks of the RM for 1994 (p.272), 1999 (p. 311), 2003 (p. 400), 2006 (p. 319), 2009 (p. 313), 2012 (p. 317); 2014 (p. 311), 2016 (p.416-424); Statistical Yearbooks of the ATULBD for 2000 (page 99), 2006 (page 93), 2009 (page 92), 2010 (page 93), 2011 (page 94), 2012 (page 98), 2014 (page 91), 2016 (page 101).

equipped with eight energy groups on coal, with an electric power of 200 MW (in service from 1964-1971, of which only five are currently operational energy groups; during 1999-2007 none was working), 2 energy groups on residual fuel oil and natural gas with an electric power of 210 MW (in service since 1973-1974, both operational) and two energy groups on natural gas, operating on gas-steam combined cycle, with an installed capacity of 250 MW each (in service since 1980, both operational).

The technological processes used by MTPP are based on the classical cycle of steam turbines with condensation and involve combusting fossil fuels for electricity generation, heat production representing only a secondary process. Electricity generation decreased by 66.0 per cent between 1990 and 2015 at MTPP (Table 1-26).

When the Russian Federation increased the price for imported natural gas, MTPP changed its tariff policy, increasing the price of electricity supplied to the Republic of Moldova.

In this context, from November 2005 through September 2009, the Republic of Moldova has stopped buying electricity from MTPP, opting for cheaper electricity imports from Ukraine. The lack of demand during 09.11.2005-11.01.2007 forced the MTPP to use just one energy unit that operated by gas-steam combined cycle based on natural gas consumption.

Between 1995 and 2015, the annual production of electricity on the left bank of the Dniester River (MTPP from Dnestrovsk and HPP Dubasari) varied between 1.7-5.2 billion kWh, of which about 40-65 per cent was exported to the right bank of Dniester River and the southern regions of Ukraine (Table1-27). The long-term strategy of the Russian company *Inter RAO EES*, who owns MTPP, is to create operating conditions for the plant to a capacity of at least 1500 MW, providing energy exports to the Balkans countries, over 6.0 billion kWh annually. In order to achieve modernization plans, beginning with 2005, the Russian company has invested about 100 million USD in upgrading MTPP.

Public Combined Heat and Power Generation

Currently, on the right bank of the Dniester there are three Combined Heat and Power Plants (CHP): in Chisinau municipality the CHP-1 and the CHP-2, and in Balti municipality: the CHP–North. Also, there are some small power plants with cogeneration at sugar plants. The installed capacity of cogeneration power plants on the right bank of the Dniester River is only about 14 per cent of the total installed capacity of power plants in the RM.

Of the total nominal installed capacity on the right bank of Dniester River, the largest share has CHP-2 in Chisinau, about 55 per cent of the total, followed by CHP-1 in Chisinau, with a share of about 14% and CHP-North in Balti, with a share of about 7%. Total nominal installed capacity in this region covers only around 30 per cent of the electricity needs.

Total production of electricity on the right bank of Dniester River decreased from approximately 1.901 billion kWh in 1990 to about 0.939 billion kWh in 2015 (Table 1-28). In the context of increasing trend of electricity consumption in the last period, this is a negative factor, including from the energy security point of view.

Table 1-26: Electricity Generation at MTPP, 1990-2015, billion kWh

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Electricity Generation	13.569	11.223	9.468	8.626	6.836	4.747	4.560	3.629	3.296	2.687	2.463	3.366	2.942
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Electricity Generation	2.793	2.891	2.701	1.347	2.482	2.622	4.862	4.723	4.494	4.615	3.031	3.893	4.610

Source: Statistical Yearbooks of the ATULBD for 2000 (pages 99, 101, 175, 183), 2006 (pages 93, 95, 173, 179), 2009 (pages 92, 94, 169, 175), 2010 (pages 93, 96, 167, 173), 2011 (pages 94, 97, 171, 177), 2012 (pages 98, 101, 175, 181), 2014 (pages 88, 91, 163, 169), 2016 (pages 98, 101, 170, 176).

Table 1-27: Electricity Generation in the ATULBD, 1995-2015

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Electricity Generation, bill. kWh, including at:	4.987	4.840	3.924	3.593	2.973	2.720	3.649	3.228	3.016	3.157	2.996
MTPP Dnestrovsk, bil. kWh	4.747	4.560	3.629	3.296	2.687	2.463	3.366	2.942	2.793	2.891	2.701
HPP Dubasari, bil. kWh	0.240	0.280	0.295	0.297	0.286	0.257	0.283	0.286	0.223	0.266	0.295
Electricity Imports in ATULBD, bill. kWh	0.000	0.000	0.000	0.000	0.003	0.014	0.000	0.285	0.921	0.812	0.659
Electricity consumption in ATULBD, bill. kWh	2.878	2.589	2.364	1.929	2.098	2.031	2.183	1.899	2.112	2.124	2.108
Electricity exports from ATULBD, bill. kWh	2.109	2.250	1.560	1.665	0.878	0.703	1.467	1.615	1.826	1.844	1.547
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Electricity Generation, bill. kWh, including at:	1.675	2.769	2.929	5.164	5.051	4.770	4.869	3.586	4.417	5.111	2.5
MTPP Dnestrovsk, bil. kWh	1.347	2.482	2.622	4.862	4.723	4.494	4.615	3.031	3.893	4.610	-2.9
HPP Dubasari, bil. kWh	0.296	0.275	0.307	0.303	0.328	0.276	0.235	0.265	0.261	0.218	-9.1
Electricity Imports in ATULBD, bill. kWh	0.276	0.000	0.000	0.002	0.002	0.002	0.002	0.002	0.002	0.002	N/A
Electricity consumption in ATULBD, bill. kWh	1.899	2.134	2.151	1.815	1.670	1.763	1.832	1.644	1.808	1.770	-38.5
Electricity exports from ATULBD, bill. kWh	0.052	0.636	0.793	3.358	3.391	3.023	3.054	1.962	2.611	3.343	58.5

Source: Statistical Yearbooks of the ATULBD for 2000 (pages 99, 101, 175, 183), 2006 (pages 93, 95, 173, 179), 2009 (pages 92, 94, 169, 175), 2010 (pages 93, 96, 167, 173), 2011 (pages 94, 97, 171, 177), 2012 (pages 98, 101, 175, 181), 2014 (pages 88, 91, 163, 169), 2016 (pages 98, 101, 170, 176).

Table 1-28: Electricity Generation on the Right Bank of Dniester River, 1990-2015, billion kWh

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Electricity Generation	1.901	1.655	1.581	1.442	1.240	1.181	1.400	1.451	1.248	1.137	0.904	1.263	1.180
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Electricity Generation	1.046	1.022	1.229	1.192	1.100	1.097	1.031	1.064	1.016	0.932	0.905	0.963	0.939

Source: NBS, Statistical Yearbooks for 1994 (p. 272), 1999 (p. 311), 2003 (p. 400), 2006 (p. 319), 2009 (p. 313), 2012 (p. 317), 2014 (p. 311), 2016 (p. 418, 422).

Public Heat Generation

There are several Heat Plants (HPs) in the Republic of Moldova, mainly operating on natural gases and residual fuel oil, less on coal and biomass. The amount of fuel consumption is accounted in the Energy Balances of the Republic of Moldova. Between 1990-2015, the total amount of heat produced in the Republic of Moldova decreased by circa 82.1 per cent, from 22.212 million Gcal in 1990 to 3.978 million Gcal in 2015 (Table 1-29).

The continuously decreasing tendency of heat generation is characteristic both to the right bank of the Dniester River, for example between 1995-2015, the decrease represented circa 59.5 per cent (from 7.097 million Gcal in 1995 to 2.397 million Gcal in 2015), as well as for the left bank of the Dniester River, where, between 1995-2015, the decrease represented circa 42.1 per cent (from 2.730 million Gcal in 1995 to 1.582 million Gcal in 2015).

Table 1-30 provides data regarding heat generation on the right bank of Dniester. As can be noted, about 66.1 per cent of the total heat generated was produced by combined heat and power plants (CHP), while 33.9 per cent was produced by heat plants (HP).

Mining and Quarrying. In 2016, the extractive industry enterprises accounted for about 1.4 per cent of the total production of large enterprises whose main business is manufacturing. These enterprises generated the sales of circa 578.1 million MDL (in current prices), by 15.8 per cent the level recorded in 2015.

1.6.2. Agricultural Production

In 2016, the agriculture production accounted circa 30.5 billion MDL (in current prices), an increase by 8.2 per cent compared to the previous year (in similar conditions) by 18.6 per cent (Figure 1-11).

The respective trend was driven by a 26.0 per cent increase in vegetable production and a 3.1 per cent increase in animal production.

Between 1991 and 2017, the agricultural production was characterized by fluctuations, with the best performance reported in 1993, 1997, 2004, 2008, 2013 and 2016, and with poor results – respectively in 1992, 1994, 1996, 1998, 2003, 2007, 2012 and 2015 (Figure 1-11, Table 1-32).

As the analysis on the influence of production types on the rhythm of crop yields indicated, in 2016, compared to the previous year, a more significant positive influence was determined by the increasing productivity of: cereals and leguminous crops (by 34.6 per cent), sun flower (by 38.9 per cent), fruits, berries and walnuts (by 19.2 per cent), potatoes (by 35.0 per cent), livestock (by 4.8 per cent), vegetables (by 12.1 per cent), grain rapeseed (by 2.7 times), which determined an increasing global agricultural production respectively by 8.1 per cent, 4.5 per cent, 1.5 per cent, 1.0 per cent, 0.9 per cent, 0.8 per cent, and by 0.7 per cent.

In 2016, the share of crop yields within the total agricultural production represented 72 per cent (in 2015 – 68 per cent), of which: cereals and leguminous crops – 26.4 per cent (23.3

Table 1-29: Heat Generation in the Republic of Moldova, including ATULBD, 1990-2015, million Gcal

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Heat Generation	22.212	16.896	12.423	10.208	7.507	9.827	9.647	9.000	8.369	6.736	4.986	5.188	5.068
Heat Consumption	20.983	15.961	11.736	8.703	6.658	8.796	8.528	7.885	7.338	5.896	4.501	4.608	4.469
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Heat Generation	5.158	4.919	5.324	5.284	4.824	4.803	4.366	4.600	4.419	4.273	4.377	4.064	3.979
Heat Consumption	4.539	4.397	4.765	4.566	4.199	4.180	3.832	3.988	3.952	3.785	3.861	3.579	3.473

Source: Energy Balances of the Republic of Moldova for 1990-2015; Statistical Yearbooks of the ATULBD for 2000 (page 99), 2006 (page 93), 2009 (page 92), 2010 (page 93), 2011 (page 94), 2012 (page 98), 2014 (page 88), 2016 (page 98).

Table 1-30: Heat Generation in the RM, 1990-2015, since 1993 only for the Right Bank of Dniester River, million Gcal

	1990	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Heat, including:	22.212	10.208	7.507	7.097	7.077	6.590	6.120	4.647	3.057	3.298	3.217	3.347
From CHP	7.220	4.657	3.641	3.528	3.659	3.294	3.127	2.534	1.847	2.113	2.128	1.922
From HP	14.802	5.542	3.862	3.568	3.417	3.296	2.991	2.113	1.207	1.183	1.087	1.423
From Other Plants	0.190	0.009	0.003	0.001	0.001	0.000	0.002	0.000	0.003	0.002	0.002	0.002
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Heat, including:	3.147	3.591	3.552	3.094	3.074	2.638	2.874	2.721	2.596	2.681	2.498	2.397
From CHP	1.922	2.140	2.165	1.855	1.939	1.647	1.874	1.780	1.701	1.655	1.661	1.585
From HP	1.423	1.451	1.358	1.386	1.133	0.990	1.000	0.940	0.895	1.022	0.837	0.812
From Other Plants	0.002	-	0.001	0.001	0.002	0.001	-	0.001	-	0.004	-	-

Source: Energy Balances of the Republic of Moldova for 1990-2015.

Table 1-31: Production of Main Industrial Products by Mining and Quarrying Industry, 2005-2016

	2005	2006	2007	2008	209	2010	2011	2012	2013	2014	2015	2016
Calcareous stones for carving or construction, alabaster, kt	474.8	512.6	568.1	522.6	399.1	346.0	350.4	316.4	286.5	317.1	279.4	188.8
Other stones for carving or construction, exclusively granites or sandstones, kt	250.3	281.5	254.5	253.5	243.0	203.6	316.3	441.8	648.2	674.1	638.4	498.5
Sand, kt	1051.9	940.6	1482.9	1511.3	1071.1	1211.1	1286.7	1373.1	1521.8	1660.0	1599.9	1522.5
Pebbles, Gravel, Boulders and Silex, kt	1370.2	1784.9	1814.9	2054.9	1349.3	1640.3	2156.4	2013.5	2492.5	2871.1	2717.1	2349.0
Sand-gravel mixture, kt	151.6	286.3	273.1	206.3	143.7	258.3	655.7	875.7	1290.1	1412.0	1087.8	1109.7

Source: National Bureau of Statistics, <http://statbank.statistica.md/pxweb/pxweb/ro/40%20Statistica%20economica/40%20Statistica%20economica__14%20IND__IND030/IND030100.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>.

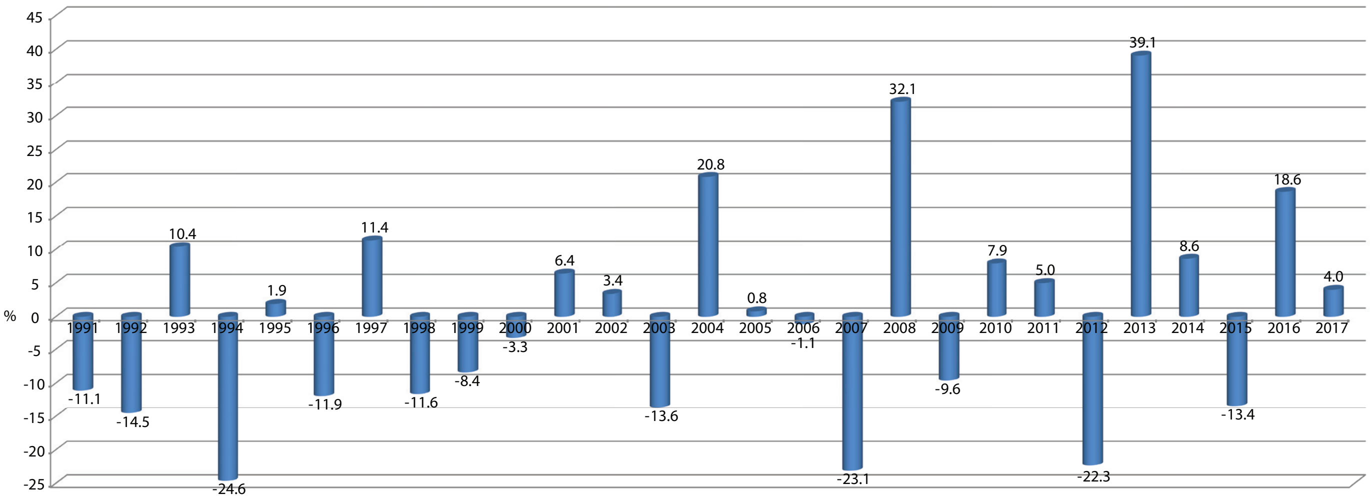


Figure 1-11: Dynamics of Agricultural Production, 1991-2017, % compared to the preceding year.

Table 1-32: RM's Agricultural Production, 1990-2017

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Agriculture, billion MDL	6.1	11.3	97.3	1.1	3.2	4.2	4.6	5.1	4.8	6.4	8.3	8.6	9.5	10.4
in % compared to the previous year		-11.1	-14.5	10.4	-24.6	1.9	-11.9	11.4	-11.6	-8.4	-3.3	6.4	3.4	-13.6
in % compared to 1990	100.0	88.9	76.0	83.9	63.3	64.5	56.8	63.3	55.9	51.2	49.5	52.7	54.5	47.1
Agriculture, billion USD				0.80	0.79	0.94	1.01	1.10	0.89	0.61	0.67	0.67	0.70	0.74
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Agriculture, billion MDL	11.8	12.7	13.7	12.8	16.5	13.3	19.9	22.6	19.9	23.8	27.3	27.2	30.5	32.3
in % compared to the previous year	20.8	0.8	-1.1	-23.1	32.1	-9.6	7.9	5.0	-22.3	39.1	8.6	-13.4	18.6	4.0
in % compared to 1990	56.9	57.3	56.7	43.6	57.6	52.1	56.2	59.0	45.9	63.8	69.3	60.0	71.1	74.0
Agriculture, billion USD	0.96	1.01	1.05	1.06	1.59	1.20	1.61	1.93	1.65	1.89	1.94	1.44	1.53	1.62

Source: Ministry of Economy of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May2017).

per cent), industrial crops – 17.4 per cent (15.1 per cent), potatoes – 3.3 per cent (2.9 per cent), vegetables – 6.3 per cent (6.7 per cent), fruits, berries and walnuts – 8.0 per cent (8.0 per cent), grapes – 7.0 per cent (8.1 per cent). The animal production accounted for 28 per cent (in2015 – 32 per cent), of which livestock and poultry – 16.0 per cent (18.2 per cent), milk – 7.9 per cent (9.4 per cent), eggs – 2.9 per cent (3.2 per cent).

To be noted that between 1990 and 2015, the gross harvest of some agricultural crops significantly decreased in the Republic of Moldova, including: perennial grass for silo and green fodder – by 89.4 per cent, annual grass for green fodder – by 78.2 per cent, forage roots – by 74.7 per cent, winter and spring barley – by 45.3 per cent, leguminous crops – by 45.1 per cent, oats – by 44.7 per cent, winter wheat– by 43.5 per cent, la grain maize – by 35.9 per cent, tobacco – by 27.3 per cent, leguminous maize – cu 24.6 per cent, sun flower – by 21.4 per cent, sugar beet – by 15.8 per cent etc. At the same time, in several sectors the production increased, including melons & gourds (by 127.7 per cent), grain sorghum (by 75.0 per cent), buckwheat (by 63.1 per cent), millet (by 11.1 per cent), winter rye (by 6.7 per cent) and potatoes (by 2.1 per cent) (Table 1-33). However, these positive results are due, in particular, to the expansion of sown areas and less to the crop yields increase (Table 1-34).

Table 1-33: Gross Harvest of Agricultural Crops, 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cereals and leguminous crops	**2538.6**	**3105.9**	**2099.8**	**3340.2**	**1753.8**	**2638.6**	**1981.2**	**3512.3**	**2751.9**
...Wheat (Winter and Spring)	1129.0	1056.5	925.8	1392.6	658.8	1154.3	673.7	1152.6	951.9
...Winter rye	1.9	1.6	1.4	2.8	2.7	5.9	9.9	10.9	7.0
...Barley (Winter and Spring)	417.9	427.0	405.0	481.0	324.9	311.2	136.7	256.9	242.2
...Oat	3.8	5.0	6.8	10.7	7.1	9.8	4.2	10.3	9.5
...Millet	0.1	0.1	0.0	0.1	0.1	0.3	0.2	0.5	0.1
...Buckwheat	1.8	5.0	2.3	5.5	3.5	2.2	3.0	4.8	4.3
...Leguminous crops	97.1	105.7	121.8	121.6	70.2	55.4	31.6	63.2	76.9
...Grain maize	885.5	1501.2	635.6	1324.5	629.3	948.6	1006.6	1788.0	1272.7
...Grain sorghum	1.2	3.1	1.1	1.4	1.1	0.8	0.1	0.5	0.2
...Other cereal crops	0.3	0.7	0.0	0.0	56.1	0.3	0.2	0.0	4.7
Industrial crops									
...Sugar beet	2374.5	1988.6	1783.4	2048.3	1526.7	1877.9	1682.1	1674.8	1356.8
...Sun flower	252.2	151.4	176.2	173.7	149.2	208.1	284.0	174.3	196.4
...Soybeans	23.8	33.4	7.9	9.3	4.0	3.3	2.5	2.7	6.0
...Tobacco	66.2	62.8	42.4	50.2	41.5	27.1	19.8	23.9	24.6
...Grain rapeseed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Potatoes, vegetables and melons & gourds									
...Potatoes	295.3	290.6	310.8	726.0	474.7	385.3	344.3	392.6	372.5
...Vegetables	1177.3	989.2	787.5	777.2	598.5	568.8	362.4	393.6	570.8
...Melons and gourds	34.4	35.6	9.3	18.6	12.6	23.3	23.3	30.4	25.9
Forage crops									
...Forage roots	1171.8	1416.4	922.5	988.6	547.0	597.0	336.5	310.2	286.4
...Maize for silo and green fodder	4509.0	4979.1	3025.9	3358.7	2285.7	2136.2	1212.0	1065.0	856.5
...Perennial grasses for green fodder, silage and fodder	4456.1	6053.5	3401.4	3514.6	2013.8	1704.7	1027.2	855.6	498.5
...Annual grasses for green fodder	288.9	420.7	339.0	339.1	190.7	222.3	143.4	96.7	106.6
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Cereals and leguminous crops	**2375.0**	**2070.2**	**2847.5**	**2791.2**	**1654.4**	**3178.0**	**3059.9**	**2371.2**	**932.5**
...Wheat (Winter and Spring)	797.8	725.0	1180.8	1113.1	102.4	861.2	1048.6	682.3	406.5
...Winter rye	6.3	5.0	9.3	5.9	0.8	5.1	6.1	1.1	0.8
...Barley (Winter and Spring)	203.1	152.3	248.4	241.7	74.4	284.1	240.9	214.6	125.7
...Oat	5.9	3.5	6.4	4.7	4.0	10.3	7.6	6.1	1.4
...Millet	0.0	0.1	0.0	0.1	0.1	0.3	0.2	0.0	0.1
...Buckwheat	6.1	8.0	6.4	1.4	1.6	1.2	1.1	0.5	0.4
...Leguminous crops	61.6	30.8	79.1	50.2	30.2	51.0	67.1	68.4	14.4
...Grain maize	1151.3	1050.4	1141.9	1206.3	1440.2	1845.1	1523.4	1327.6	363.2
...Grain sorghum	0.3	0.5	1.1	0.5	4.4	3.4	0.3	0.5	0.1
...Other cereal crops	6.0	3.2	5.7	4.2	0.7	3.7	12.3	15.2	1.1
Industrial crops									
...Sugar beet	956.4	982.5	1120.6	1157.4	660.3	911.3	996.2	1177.3	612.3
...Sun flower	291.6	305.1	278.3	340.9	421.4	354.8	368.7	396.1	158.7
...Soybeans	13.7	11.6	10.5	12.6	19.4	40.2	66.4	80.2	40.0
...Tobacco	22.6	26.3	16.3	12.4	7.2	7.9	6.7	4.9	3.6
...Grain rapeseed	1.2	1.1	1.0	1.0	1.2	1.1	3.4	6.9	34.9
Potatoes, vegetables and melons & gourds									
...Potatoes	330.6	330.4	388.6	326.0	303.2	321.8	391.1	384.1	200.9
...Vegetables	535.8	396.1	487.4	408.4	371.7	328.7	410.3	490.6	226.6
...Melons and gourds	33.9	31.7	39.3	29.0	72.7	57.3	49.3	92.6	41.2
Forage crops									
...Forage roots	170.1	125.0	63.5	67.9	55.7	52.7	41.6	34.9	13.8
...Maize for silo and green fodder	428.6	350.7	316.4	322.8	327.9	219.4	199.6	153.3	104.6
...Perennial grasses for green fodder, silage and fodder	506.8	317.4	201.5	173.4	145.4	206.7	183.8	194.9	177.0
...Annual grasses for green fodder	53.7	28.8	19.3	16.0	12.6	12.6	16.3	13.6	7.4
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Cereals and leguminous crops	**3261.6**	**2375.5**	**2674.3**	**2794.6**	**1359.0**	**3130.4**	**3341.0**	**2587.0**	**1.9**
...Wheat (Winter and Spring)	1286.5	738.9	749.5	797.1	496.9	1009.6	1102.6	927.4	-17.9
...Winter rye	2.0	3.4	2.4	1.0	2.6	5.7	1.4	1.0	-47.7
...Barley (Winter and Spring)	362.3	290.5	240.7	218.9	139.3	241.6	244.7	199.1	-52.4
...Oat	3.9	1.6	3.1	3.6	2.0	3.8	2.9	1.7	-56.4
...Millet	0.5	0.7	0.3	0.1	0.1	0.1	0.1	0.1	0.0
...Buckwheat	0.5	0.6	0.5	0.5	0.3	0.5	0.4	0.2	-88.4
...Leguminous crops	38.0	32.0	40.1	33.1	17.3	24.1	32.9	25.1	-74.2
...Grain maize	1484.1	1159.6	1462.1	1547.2	587.2	1546.8	1642.1	1133.6	28.0
...Grain sorghum	0.1	0.2	0.2	0.1	0.1	0.4	0.3	0.2	-85.4
...Other cereal crops	8.1	5.3	7.7	4.8	2.1	5.5	8.3	2.7	808.3
Industrial crops									
...Sugar beet	960.7	337.4	837.6	588.6	587.0	1009.0	1356.2	537.5	-77.4
...Sun flower	387.2	310.2	440.2	497.4	339.1	602.2	627.1	562.3	123.0
...Soybeans	58.8	50.1	113.0	80.6	48.9	67.6	111.4	49.2	106.5
...Tobacco	3.9	4.4	7.6	5.4	2.9	2.2	1.4	1.2	-98.2
...Grain rapeseed	100.1	81.6	51.0	67.7	8.1	58.8	90.2	25.6	NA
Potatoes, vegetables and melons & gourds									
...Potatoes	273.7	264.8	286.7	362.9	191.5	244.0	275.7	163.8	-44.5
...Vegetables	389.4	322.8	365.8	396.0	251.9	319.1	352.3	266.9	-77.3
...Melons and gourds	69.9	102.4	104.9	85.2	52.6	56.6	48.3	56.7	64.8
Forage crops									
...Forage roots	26.4	20.0	31.7	23.2	10.6	22.2	26.1	14.6	-98.8
...Maize for silo and green fodder	113.0	106.4	143.8	125.2	110.8	168.2	135.7	91.8	-98.0
...Perennial grasses for green fodder, silage and fodder	364.2	213.4	323.9	238.5	97.6	198.6	275.0	118.5	-97.3
...Annual grasses for green fodder	15.3	7.9	10.9	11.3	6.3	9.6	13.4	8.8	-97.0

Source: NBS on-line database, Section "Sown Area, crops average yield and harvest within 1990-2015": <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks for ATULBD 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 98), 2011 (page 101), 2014 (page 95), 2016 (page 108).

Table 1-34: Average Yield per Hectare of Agricultural Crops in the RM, 1990-2015, t/ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cereals and leguminous crops	**3.4**	**3.7**	**2.8**	**3.7**	**2.1**	**2.9**	**2.2**	**3.3**	**2.6**
...Wheat (Winter and Spring)	3.9	3.5	3.3	4.0	2.2	2.9	1.8	2.8	2.3
...Winter rye	2.1	2.0	2.0	2.6	1.6	2.2	2.1	2.8	1.9
...Barley (Winter and Spring)	3.5	3.2	3.3	3.5	2.2	2.3	1.3	2.0	1.8
...Oat	1.8	1.7	2.3	2.7	1.4	1.7	1.1	1.6	1.6
...Millet	1.0	1.0	0.4	1.0	0.6	1.4	0.7	1.6	0.4
...Buckwheat	0.5	0.8	0.3	0.8	0.4	0.4	0.4	0.7	0.4
...Leguminous crops	1.3	1.4	1.7	1.7	1.1	1.0	0.7	1.4	1.3
...Grain maize	3.4	4.8	2.5	3.9	2.2	3.0	2.9	4.0	3.1
...Grain sorghum	1.0	1.0	2.2	4.6	0.9	0.8	0.3	1.7	0.9
...Other cereal crops	3.0	3.1	2.6	2.8	2.1	0.3	1.4	0.0	2.1
Industrial crops									
...Sugar beet	29.1	24.9	21.6	22.5	16.7	20.8	20.0	22.0	17.8
...Sun flower	1.9	1.2	1.3	1.2	0.9	1.3	1.3	0.9	0.8
...Soybeans	0.9	1.4	0.5	1.0	0.7	1.0	1.0	1.1	0.9
...Tobacco	2.1	1.9	1.5	1.6	1.5	1.3	1.2	1.4	1.1
...Grain rapeseed	2.0	2.0	1.6	1.2	1.0	0.8	0.7	1.0	0.9
Potatoes, vegetables and melons & gourds									
...Potatoes	7.2	6.2	5.6	10.0	7.4	6.8	5.8	6.3	6.0
...Vegetables	16.6	12.7	10.7	8.7	7.2	7.7	5.9	6.2	9.7
...Melons and gourds	3.7	4.5	1.3	2.8	2.3	3.1	3.5	3.8	5.0
Forage crops									
...Forage roots	44.4	47.2	31.8	32.6	20.9	24.4	19.1	19.0	18.5
...Maize for silo and green fodder	15.4	24.9	10.1	13.8	7.5	11.9	6.7	10.8	8.8
...Perennial grasses for green fodder, silage and fodder	21.6	29.5	18.6	17.7	11.2	11.8	8.3	8.3	6.6
...Annual grasses for green fodder	9.2	15.7	9.7	10.4	4.9	7.6	5.3	5.8	6.2

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Cereals and leguminous crops	**2.3**	**1.9**	**2.4**	**2.4**	**1.8**	**2.8**	**2.7**	**2.5**	**0.9**
...Wheat (Winter and Spring)	2.0	1.7	2.4	2.2	0.5	2.5	2.3	2.2	1.2
...Winter rye	1.6	1.3	1.7	1.6	0.6	2.0	1.9	1.6	1.1
...Barley (Winter and Spring)	1.6	1.2	2.2	1.8	0.8	2.0	1.6	1.7	0.9
...Oat	1.2	0.8	1.3	1.1	0.9	1.7	1.2	1.3	0.3
...Millet	0.1	0.2	0.8	0.5	0.5	0.7	0.9	0.5	0.1
...Buckwheat	0.4	0.7	0.5	0.3	0.3	0.3	0.4	0.1	0.3
...Leguminous crops	1.0	0.6	1.5	0.8	0.6	1.3	1.6	1.6	0.4
...Grain maize	2.8	2.3	2.3	2.7	2.5	3.1	3.2	2.9	0.8
...Grain sorghum	3.1	1.3	1.1	0.9	1.4	0.9	0.4	1.1	0.5
...Other cereal crops	3.6	161.2	7.5	6.0	0.9	1.5	2.0	2.0	0.8
Industrial crops									
...Sugar beet	14.6	14.8	17.7	22.3	16.6	26.1	29.0	27.8	17.9
...Sun flower	1.2	1.2	1.2	1.2	1.1	1.2	1.2	1.3	0.7
...Soybeans	0.8	1.0	1.1	1.2	1.1	1.4	1.8	1.4	0.8
...Tobacco	1.2	1.1	0.9	1.3	1.3	1.4	1.4	1.4	1.2
...Grain rapeseed	1.2	1.0	1.0	1.0	1.0	1.2	1.4	1.0	0.8
Potatoes, vegetables and melons & gourds									
...Potatoes	5.0	5.1	9.0	7.2	7.9	9.2	10.6	11.0	5.6
...Vegetables	9.5	7.0	7.0	7.0	8.5	8.6	10.3	11.0	5.7
...Melons and gourds	5.7	4.0	5.2	4.5	8.4	7.8	9.4	10.2	5.8
Forage crops									
...Forage roots	11.9	10.9	14.0	16.6	12.3	14.2	16.4	11.6	7.4
...Maize for silo and green fodder	6.8	7.1	7.8	9.2	7.4	8.9	11.0	9.6	4.2
...Perennial grasses for green fodder, silage and fodder	8.7	6.0	4.2	3.5	2.9	3.9	3.1	3.1	2.6
...Annual grasses for green fodder	3.2	2.6	2.4	1.8	1.1	2.1	2.0	2.3	1.3

	2008	2009	2010	2011	2012	2013	2014	2015	%
Cereals and leguminous crops	**3.2**	**2.3**	**2.6**	**2.8**	**1.3**	**2.9**	**3.2**	**2.4**	**-28.7**
...Wheat (Winter and Spring)	3.0	1.9	2.0	2.3	1.3	2.3	2.7	2.2	-43.5
...Winter rye	1.9	1.8	1.5	1.8	2.0	2.8	2.8	2.3	6.7
...Barley (Winter and Spring)	2.6	1.6	1.5	1.7	1.2	1.9	2.0	1.9	-45.3
...Oat	1.4	0.7	1.0	1.6	0.9	1.5	1.4	1.0	-44.7
...Millet	1.7	2.5	0.5	0.7	0.6	1.1	1.5	1.1	11.1
...Buckwheat	0.6	0.6	3.2	0.8	0.3	1.6	1.5	0.8	63.1
...Leguminous crops	1.3	0.9	1.0	1.1	0.7	1.0	1.5	1.0	-24.6

	2008	2009	2010	2011	2012	2013	2014	2015	%
...Grain maize	3.5	2.8	3.4	3.3	1.1	3.2	3.3	2.2	-35.9
...Grain sorghum	0.5	0.8	0.9	0.7	0.5	3.0	2.8	1.8	75.0
...Other cereal crops	2.1	1.7	1.8	1.9	1.9	2.0	2.1	2.2	-26.3
Industrial crops									
...Sugar beet	38.9	14.4	31.6	23.2	18.8	35.2	48.4	24.5	-15.8
...Sun flower	1.6	1.2	1.5	1.6	1.0	1.7	1.7	1.5	-21.4
...Soybeans	1.9	1.0	1.9	1.4	0.8	1.6	2.0	0.7	-21.5
...Tobacco	1.4	1.8	1.7	1.4	1.2	1.5	1.6	1.5	-27.3
...Grain rapeseed	1.9	1.2	1.0	1.3	1.0	1.6	2.4	1.9	-3.5
Potatoes, vegetables and melons & gourds									
...Potatoes	8.7	9.3	10.2	12.2	7.6	10.1	11.9	7.3	2.1
...Vegetables	9.3	8.7	9.0	10.6	7.2	8.6	9.9	9.1	-45.1
...Melons and gourds	7.9	8.6	9.9	10.4	7.2	7.3	6.6	8.5	127.7
Forage crops									
...Forage roots	14.1	13.7	18.5	19.0	7.4	18.5	20.1	11.2	-74.7
...Maize for silo and green fodder	11.0	9.4	14.2	12.0	5.0	19.2	14.5	8.2	-46.8
...Perennial grasses for green fodder, silage and fodder	6.0	3.5	4.8	3.9	1.7	3.4	5.0	2.3	-89.4
...Annual grasses for green fodder	3.3	2.2	1.7	2.3	1.6	2.2	3.4	2.0	-78.2

Source: NBS on-line database, Section "Sown Area, crops average yield and harvest 1990-2015": <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks for ATULBD: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 99), 2011 (page 102), 2014 (page 96), 2016 (page 110).

Plant Production. In 2016, agricultural production data show a significant increase driven by the growth of average crop harvest due to the year good weather conditions.

Compared to the previous year, the global crop yield increased by 772 kt or by 35 per cent more (including wheat – by 368 kt or 40 per cent, grain maize – by 302 kt or 28 per cent), sugar beet - by 53 kt (by 10 per cent), sun flower – by 188 kt (39 per cent), grain rapeseed – by 27 kt (2,7 times), potatoes - by 56 kt (35 per cent), vegetables – by 47 kt (19 per cent), fruits, berries and walnuts - by 105 kt (22 per cent) and grapes – by 16 kt (3 per cent). In 2016, the agricultural enterprises have the main share in the production of: sugar beet – 93 per cent, grain rapeseed – 92 per cent, soybeans – 78 per cent, tobacco – 77 per cent, cereals and leguminous crops (exclusive corn) and sun flower – 73 per cent. At the same time, farm households and peasant (family) farms have the main share in the production of: melon & gourds - 98 per cent of the total, potatoes - 89 per cent, vegetables - 86 per cent, grapes -75 per cent, grain maize - 72 per cent and fruits, berries and walnuts - 65 per cent.

Over the 1990-2015 periods, the amount of synthetic and organic fertilizers applied to soils in the RM decreased by circa 77.5 per cent and, respectively, 99.4 per cent (Table 1-35).

On average, about 31 kg of synthetic fertilizer were applied per one hectare of sown fields, recalculated to 100 per cent nutrients (active substance – a.s.), compared to 134 kg applied in 1990 (by 77.6 per cent less). As for the organic fertilizers, about 36 kg were applied per one hectare, compared to 5.6 tons in 1990. In 2016, in agricultural enterprises and farm households there were introduced about 50 kg of synthetic fertilizers (recalculated to 100 per cent a.s.), respectively 80 kg of organic fertilizers per one hectare of sown fields.

Livestock. Between 1990 and 2016, the livestock production significantly decreased in the RM, including cattle and poultry sold for slaughter (in live weight) – by 65.2 per cent, milk yield – by 69.3 per cent, egg production – by 41.4 per cent and wool production – by 43.8 per cent (Table 1-36).

In 2016, compared to the previous year, the production of cattle and poultry in live weight increased for all categories of producers by 5 per cent (in agricultural enterprises – by 12.1 per cent, in farm households – by 0.8 per cent). Egg production increased by 6.6 per cent (in agricultural enterprises – by 14.4 per cent, in farm households – by 1.5 per cent). At the same time, milk production (for all categories) decreased by 1.2 per cent. In farm households milk production decreased by 1.6 per cent, while in agricultural enterprises – an increase by 6.8 per cent was recorded.

Table 1-35: Applied Synthetic and Organic Fertilizers in the RM, 1990-2015, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Synthetic fertilizers (a.s.), kt	**232.4**	**191.4**	**127.6**	**44.9**	**20.0**	**12.5**	**14.3**	**12.1**	**10.3**	**6.1**	**10.3**	**12.8**	**18.4**
nitrogen	92.1	82.7	61.8	26.4	14.1	10.5	13.2	11.4	10.2	5.9	10.2	12.7	18.0
phosphorus	85.7	75.2	43.4	12.7	8.0	1.4	0.7	0.5	0.1	0.1	0.1	0.1	0.3
potassium	54.6	33.5	22.4	5.8	1.6	0.6	0.3	0.2	0.0	0.0	0.0	0.0	0.1
On average kg/1 sown ha	134.1	111.5	74.6	25.2	11.7	7.2	8.3	7.0	6.0	3.7	6.1	7.5	10.6
Organic fertilizers, kt	**9740**	**8600**	**5300**	**4200**	**1620**	**1779**	**906**	**353**	**227**	**122**	**83**	**98**	**54**
On average kg/1 sown ha	5620	5009	3097	2360	944	1031	527	204	132	73	49	57	31
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Synthetic fertilizers (a.s.), kt	**15.4**	**17.5**	**18.0**	**16.6**	**22.4**	**24.7**	**19.9**	**25.5**	**30.9**	**44.0**	**54.8**	**84.5**	**52.4**
nitrogen	14.6	16.1	16.1	13.8	18.8	21.9	17.0	20.6	25.0	34.1	42.1	61.1	38.7
phosphorus	0.6	1.0	1.5	2.0	2.4	1.7	2.0	3.3	4.1	7.1	9.6	19.4	10.8
potassium	0.2	0.4	0.5	0.8	1.1	1.1	0.9	1.6	1.8	2.8	3.1	4.0	2.9
On average kg/1 sown ha	9.7	10.4	11.1	10.7	14.4	15.9	13.1	15.8	19.2	26.8	32.7	50.2	31.2
Organic fertilizers, kt	**47**	**42**	**44**	**10**	**8**	**8**	**7**	**18**	**31**	**23**	**43**	**34**	**61**
On average kg/1 sown ha	30	25	27	7	5	5	5	11	20	14	25	20	36

Source: Statistical Yearbooks of the RM for 1988 (page 280), 1994 (page 239), 1999 (page 330), 2003 (page 442), 2006 (page 352), 2011 (page 345) 2014 (page 345) and 2016 (page 461). Statistical Yearbooks of the ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2012 (page 114), 2014 (page 103), 2016 (page 106).

Table 1-36: The Main Livestock Products Produced in the RM, 1990-2016

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Cattle and poultry sold for slaughter (in live weight), kt	530	433	334	228	193	174	166	161	145	147	123	115	120	118
...cattle	181	154	121	99	91	70	58	49	37	35	30	26	27	27
...swine	238	189	150	88	66	67	73	76	75	81	63	56	57	55
...sheep and goats	15	10	8	9	10	11	10	9	8	8	7	6	6	6
...poultry	92	76	52	30	23	24	24	25	24	21	21	26	28	29
...other species	4	4	3	2	3	2	2	2	2	2	1	2	2	2
Milk yield, kt	1 503	1 284	1 128	867	805	751	671	597	589	569	555	561	583	570
Eggs, million pcs	1 129	1 061	813	530	418	477	526	512	539	555	575	618	671	620
Wool, tons	3 043	2 869	2 616	2 598	2 812	2 895	2 808	2 711	2 433	2 278	2 066	2 074	2 072	2 057
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Cattle and poultry sold for slaughter (in live weight), kt	119	121	134	150	108	125	150	159	156	155	164	175	185	-65.2
...cattle	27	26	25	25	18	18	17	16	16	14	14	14	16	-91.3
...swine	53	51	61	75	45	54	73	81	82	78	82	92	93	-61.0
...sheep and goats	6	5	5	5	5	5	5	5	5	4	4	4	4	-72.0
...poultry	33	37	41	42	40	46	55	55	52	57	62	63	70	-24.0
...other species	2	2	2	2	2	2	2	2	2	2	2	2	2	-57.5
Milk yield, kt	604	627	595	571	511	539	591	526	490	486	485	480	462	-69.3
Eggs, million pcs	668	762	765	704	563	640	719	705	622	624	645	629	662	-41.4
Wool, tons	2 028	2 079	2 170	2 146	2 021	1 996	2 067	2 043	1 843	1 899	1 947	1 899	1 711	-43.8

Source: Statistical Yearbooks of the ATULBD for 2000 (page 116), 2002 (page 120), 2006 (page 111), 2009 (page 110), 2012 (page 117), 2014 (page 106), 2016 (page 115). National Bureau of Statistics: <http://statbank.statistica.md/pxweb/pxweb/ro/40%20Statistica%20economica/40%20Statistica%20economica__16%20AGR__AGR030/AGR030200.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>.

Over the 1990-2015 periods, the livestock population related to particular species decreased sharply: cattle – by 80.7 per cent (dairy cows – by 65.0 per cent, other cattle – by 90.0 per cent), swine – by 73.8 per cent, poultry of all categories – by 49.5 per cent, sheep – by 41.5 per cent, horses – by 15.0 per cent. At the same time, during the period under review it was reported an increase regarding other species such as: goats – by 310.2 per cent, rabbits – by 23.7 per cent, asses and mules – by 16.0 per cent (Table 1-37).

As of December 31, 2016, in comparison to the respective period in the previous year, a decrease was recorded regarding the livestock – cows, sheep and goats both within the agricultural enterprises, as well as within farm households. At the same time, within the reference period, the number of cattle and swine within the agricultural enterprises increased. In 2016, the agricultural enterprises recorded an increase by 7 per cent in milk yield compared to 2015, while the total egg production registered an increase by 15 per cent.

Table 1-37: Total Livestock and Poultry in all Households Categories in the Republic of Moldova in 1990-2015 (as of the end of the year), thousand heads

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Cattle	1 060.7	1 000.5	970.1	882.6	832.0	729.5	646.3	549.7	532.4
Dairy Cows	395.2	397.1	403.2	401.8	402.6	380.8	355.4	323.7	318.4
Other cattle	665.5	603.4	566.9	480.7	429.4	348.7	290.9	226.0	214.0
Sheep and goats	1 281.9	1 288.8	1 357.2	1 437.3	1 501.9	1 423.0	1 372.4	1 235.3	1 147.2
Sheep	1 244.8	1 239.3	1 294.3	1 362.5	1 410.4	1 328.2	1 273.7	1 139.3	1 050.5
Goats	37.1	49.5	62.9	74.7	91.5	94.7	98.7	95.9	96.7
Horses	47.2	48.4	51.4	54.5	58.2	61.6	63.3	65.4	68.5
Asses and mules	1.7	1.8	2.1	2.2	2.9	3.2	3.1	3.0	3.2
Swine	1 850.1	1 753.0	1 487.4	1 082.3	1 046.8	1 014.6	950.1	797.5	928.0
Poultry:	24 625.0	23 715.0	17 128.0	12 809.2	13 448.3	13 744.9	12 364.9	12 363.9	13 046.0
...Chicken	20 234.4	19 607.1	13 271.0	9 516.6	9 957.4	10 199.5	9 137.4	9 112.0	9 557.0
...Geese	1 335.5	1 321.8	1 300.4	1 378.9	1 457.0	1 487.2	1 357.9	1 372.3	1 470.0
...Ducks	2 165.7	1 914.7	1 736.5	1 198.9	1 284.8	1 293.1	1 166.6	1 169.5	1 264.8
...Turkey	889.3	871.3	820.2	714.8	749.0	765.1	703.0	710.1	754.2
Rabbits	283.0	250.8	298.5	262.4	237.2	209.3	189.8	176.8	185.9
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Cattle	482.4	445.4	453.6	454.7	409.1	359.5	339.8	326.9	253.7
Dairy Cows	306.9	298.5	300.1	304.8	277.7	249.0	233.1	222.0	180.8
Other cattle	175.5	146.9	153.5	149.9	131.5	110.5	106.7	104.9	72.9
Sheep and goats	1 055.5	962.1	971.7	978.4	958.4	959.8	954.3	962.5	866.4
Sheep	953.2	850.7	857.0	849.1	834.8	838.1	832.8	848.7	765.5
Goats	102.4	111.4	114.6	129.2	123.6	121.7	121.5	113.8	100.9
Horses	72.0	76.0	81.6	82.6	81.4	75.8	72.0	69.3	60.5
Asses and mules	3.4	3.8	4.3	4.0	4.3	4.0	3.7	3.6	3.1
Swine	751.3	492.7	489.2	550.1	476.4	422.3	493.0	568.3	320.8
Poultry:	13 730.1	13 624.9	14 730.4	15 525.5	16 194.2	17 881.6	22 771.6	23 014.6	17 500.6
...Chicken	9 992.5	9 952.9	10 947.5	11 474.7	12 182.9	13 556.7	17 193.3	17 318.1	14 118.4
...Geese	1 581.6	1 550.6	1 589.2	1 777.4	1 780.2	1 828.0	2 120.3	2 111.5	1 342.2
...Ducks	1 349.4	1 325.3	1 367.5	1 423.3	1 461.9	1 592.6	2 394.1	2 551.0	1 435.5
...Turkey	806.6	796.2	826.2	850.1	769.3	904.4	1 063.9	1 034.0	604.5
Rabbits	182.6	161.3	191.4	190.7	205.4	239.1	278.9	326.0	263.4

	2008	2009	2010	2011	2012	2013	2014	2015	%
Cattle	238.4	243.0	236.4	224.4	210.6	208.0	210.7	204.5	-80.7
Dairy Cows	171.8	173.2	166.1	156.0	145.5	141.6	141.4	138.2	-65.0
Other cattle	66.6	69.8	70.3	68.4	65.1	66.4	69.3	66.3	-90.0
Sheep and goats	879.6	929.7	920.6	846.2	836.9	862.0	887.0	880.8	-31.3
Sheep	774.0	816.7	801.2	722.0	706.4	725.0	740.6	728.7	-41.5
Goats	105.6	112.9	119.4	124.2	130.4	137.1	146.4	152.1	310.2
Horses	57.4	56.1	53.6	50.9	47.5	46.0	42.8	40.2	-15.0
Asses and mules	3.2	2.9	2.8	2.5	2.4	2.1	2.2	2.0	16.0
Swine	302.9	403.6	511.7	471.7	438.4	444.8	504.7	484.5	-73.8
Poultry:	18 652.1	22 880.2	23 671.7	19 669.2	15 766.3	11 932.9	12 472.0	12 429.2	-49.5
...Chicken	15 285.5	18 729.6	19 338.4	16 096.5	13 121.2	10 081.3	10 390.5	10 494.2	-48.1
...Geese	1 277.2	1 497.4	1 600.2	1 351.6	1 028.5	718.7	768.0	734.0	-45.0
...Ducks	1 501.7	1 981.8	2 013.6	1 622.1	1 166.9	822.4	986.1	894.5	-58.7
...Turkey	587.8	671.4	719.5	599.0	449.6	310.6	327.4	306.5	-65.5
Rabbits	248.5	274.5	277.0	277.4	267.0	296.2	326.1	350.2	23.7

Source: NBS, Statistical Annual Report No. 24-agr „Animal Breeding Sector", the number of livestock and poultry in all Households Categories as of 1st of January (annually for 1990-2015 periods). Statistical Yearbooks of the ATULBD for 1998 (pag224), 2002 (page 118), 2006 (page 109), 2010 (page110), 2014 (page 104), 2016 (page113).

1.6.3. Transport and Communication

RM's transport sector is comprised of the following segments: road transportation, railway transport, air transportation and naval transportation.

Road Transportation. The national network of roads has a total length of 10 897 km (including: 9386 km – on the right bank of Dniester, 1511 km – on the left bank of Dniester; hard-surface roads: 8894 km – on the right bank of Dniester and 1470 km – on the left bank of Dniester) (Table 1-38) has the municipality of Chisinau as its principal hub, intersection of the principal national and international roads crossing the country. The roads network is sufficiently developed (the public roads density represents about 322 km/1000 km^2, while the hard-surface roads - circa 306 km/1000 km^2), but the state of the roads and the infrastructure in general is deplorable, though in the last six years repairs and restoration of the national road network are being widely performed.

In the RM road transportation is represented by a wide range of transport means: cars, buses and minibuses, trucks, special destination vehicles (ambulances, fire fighting vehicles, hook-and-ladder trucks, mobile cranes and other) (Table 1-39).

During the period under review, the number of special destination vehicles decreased significantly – by 70.6 per cent, while the number of cars increased by 213.0 per cent, buses and minibuses - 89.3 per cent and trucks – by 119.7 per cent. The main types of fuels consumed by road transportation are Gasoline, Diesel Oil, Liquefied Petroleum Gases – LPG and Liquefied Natural Gases – LNG.

Table 1-38: Length and Density of Road Communication Lines by the end of the year in the RM, per 1,000 km^2, 1997-2016

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Public Roads – total, km	10680	10679	10678	10655	10711	10739	10740	10743	10746	10746
On the Right Bank of Dniester, km	9403	9402	9401	9378	9433	9461	9462	9464	9467	9467
On the Left Bank of Dniester, km	1277	1277	1277	1277	1278	1278	1278	1279	1279	1279
With hard surface, km	10143	10142	10141	10003	10059	10101	10102	10105	10108	10112
On the Right Bank of Dniester, km	8920	8919	8918	8780	8835	8877	8878	8880	8883	8887
On the Left Bank of Dniester, km	1223	1223	1223	1223	1224	1224	1224	1225	1225	1225
Density of Public Roads, km/1000 km^2	315.5	315.5	315.5	314.8	316.5	317.3	317.3	317.4	317.5	317.5
On the Right Bank of Dniester, km	316.7	316.7	316.7	316.0	317.8	318.8	318.8	318.8	318.9	318.9
On the Left Bank of Dniester, km	306.7	306.7	306.7	306.7	307.0	307.0	307.0	307.2	307.2	307.2
With hard surface, km/1000 km^2	299.6	299.6	299.6	295.6	297.2	298.5	298.5	298.6	298.6	298.8
On the Right Bank of Dniester, km	300.5	300.4	300.5	295.8	297.7	299.1	299.1	299.2	299.3	299.4
On the Left Bank of Dniester, km	293.8	293.8	293.8	293.8	294.0	294.0	294.0	294.3	294.3	294.3
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Public Roads – total, km	10615	10621	10817	10818	10826	10826	10826	10871	10884	10897
On the Right Bank of Dniester, km	9337	9343	9344	9344	9352	9352	9352	9360	9373	9386
On the Left Bank of Dniester, km	1278	1278	1473	1474	1474	1474	1474	1511	1511	1511
With hard surface, km	10015	10034	10234	10239	10257	10265	10266	10331	10349	10364
On the Right Bank of Dniester, km	8791	8810	8811	8811	8827	8835	8836	8861	8879	8894
On the Left Bank of Dniester, km	1224	1224	1423	1428	1430	1430	1430	1470	1470	1470
Density of Public Roads, km/1000 km^2	313.6	313.8	319.6	319.6	319.9	319.9	319.9	321.2	321.6	322.0
On the Right Bank of Dniester, km	314.6	314.8	314.8	314.8	315.1	315.1	315.1	315.3	315.8	316.2
On the Left Bank of Dniester, km	307.0	307.0	353.8	354.1	354.1	354.1	354.1	363.0	363.0	363.0
With hard surface, km/1000 km^2	295.9	296.5	302.4	302.5	303.0	303.3	303.3	305.2	305.8	306.2
On the Right Bank of Dniester, km	296.2	296.8	296.8	296.8	297.4	297.6	297.7	298.5	299.1	299.6
On the Left Bank of Dniester, km	294.0	294.0	341.8	343.0	343.5	343.5	343.5	353.1	353.1	353.1

Source: Statistical Yearbooks of the RM for 2003 (page 500), 2006 (page 405), 2012 (page 400), 2014 (page 397), 2016 (page 534). Statistical Yearbooks of the ATULBD for 2000 (page 127), 2006 (page 121), 2009 (page 119), 2010 (page 123), 2012 (page 128), 2014 (page 117), 2016 (page 124).

Table 1-39: Road Transportation Means Existent by the end of the year in the RM (including in the ATULBD) within 1990-2016 periods, units

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Trucks	76909	77941	61595	63235	62171	61433	58597	58206	58558	53439	47501	47099	47442	47873
Buses and Minibuses	11305	11226	8924	9101	9139	9697	10282	11623	13345	14005	13176	15094	16132	16069
Cars	208984	218059	166259	166440	169387	232866	245515	289105	306825	323264	329431	347574	360488	356752
Special Destination Vehicles	20328	19632	16155	15241	15228	17255	16314	14981	14076	12455	11024	10437	9918	9311
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Trucks	74684	82545	84682	95587	116804	120639	131585	142015	152245	154537	160532	164878	168963	119.7
Buses and Minibuses	20063	20123	21336	21672	22062	21939	21973	21919	21985	21792	21788	21565	21399	89.3
Cars	359248	386034	414315	441991	470926	492481	512386	537145	574647	611812	642985	637140	654108	213.0
Special Destination Vehicles	9058	8951	8510	8186	7983	7631	7373	7098	6747	6552	6355	6165	5980	-70.6

Source: Statistical Yearbooks of the RM for 1994 (page 325), 1999 (page 390), 2006 (page 407), 2008 (page 399), 2010 (page 399), 2012 (page 402), 2014 (page 399), 2016 (page 538). Statistical Yearbooks of the ATULBD for 2000 (page 127), 2006 (page 121), 2009 (page 119), 2010 (page 123), 2012 (page 128), 2014 (page 117).

In 2016, the total volume of freight transportation with motor vehicles represented 33.4 million tons which is a decrease by 87.3 per cent compared to the 1990 level, but an increase of 3.0 per cent as compared to 2015 (Table 1-42). Buses and minibuses transported 106.0 mill. passengers, by 76.3 per cent less than in 1990, but an increase by 2.4 per cent compared to 2015 (Table 1-43).

Railways. The history of railway transportation dates back 140 years. The total length of railway lines is 1157 km, while the density per 1,000 km^2 is 34 km (Table 1-40).

The railway transport in the RM is assured by Diesel Locomotives (400-4000 kW), Maneuvering Locomotives (200-2000 kW), Diesel Trains, Cargo and Passenger Trains.

To be noted that during the period under review the rolling stock has decreased significantly: Diesel Locomotives (over 350 HP) (by circa 57.4 per cent), Diesel Trains (by circa 54.1 per cent), Cargo Wagons (by circa 54.9 per cent) and Passenger Coaches (by circa 28.8 per cent) (Table 1-41). The main type of fuel used in railways is Diesel Oil. Other types of fuels, such as: Coal, Residual Fuel Oil, Gasoline, Natural Gas and Lubricants are also used for auxiliary needs.

The main type of fuel used in railways is Diesel Oil. Other types of fuels, such as: Coal, Residual Fuel Oil, Gasoline, Natural Gas and Lubricants are used for auxiliary needs. The railway transport employs around 15,000 persons. An important railway segment 45 km long was constructed and commissioned in 2005 to connect Revaca and Cainari and to enable the transportation of freights and passengers to the south of the RM without the necessity to go through the town of Bender in ATULBD. Furthermore, the construction of the railway section Cahul - Giurgiulesti 50 km was completed in 2008 to connect the railway network with the port Giurgiulesti, ensuring a direct link to the Danube transport system.

In 2016, railways accounted for 3.5 million tons of the total freight transportation, registering an decrease of 94.7 per cent as compared to 1990, respectively by 16.0 per cent as compared to 2015 (Table 1-42).

Table 1-40: Length (km) and Density (km per 1,000 km^2) of Railways by the end of the year in the Republic of Moldova, 1990-2017

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Railways, km	1150	1150	1150	1150	1150	1150	1150	1140	1137	1140	1139	1121	1120	1111
on RBDR, km	977	977	977	977	977	977	977	967	964	967	999	981	980	971
on LBDR, km	173	173	173	173	173	173	173	173	173	173	140	140	140	140
Railways density, km/1000 km^2	34.1	34.0	34.0	34.0	34.0	34.0	34.0	33.7	33.6	33.7	33.7	33.1	33.1	32.8
on RBDR, km	33.0	32.9	32.9	32.9	32.9	32.9	32.9	32.6	32.5	32.6	33.7	33.1	33.0	32.7
on LBDR, km	41.6	41.6	41.6	41.6	41.6	41.6	41.6	41.6	41.6	41.6	33.6	33.6	33.6	33.6
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Railways, km	1075	1139	1154	1154	1157	1157	1157	1157	1157	1157	1156	1151	1151	1151
on RBDR, km	970	1034	1049	1049	1043	1043	1043	1043	1043	1043	1042	1037	1037	1037
on LBDR, km	105	105	105	105	114	114	114	114	114	114	114	114	114	114
Railways density, km/1000 km^2	31.8	33.7	34.1	34.1	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.0	34.0	34.0
on RBDR, km	32.7	34.8	35.3	35.3	35.1	35.1	35.1	35.1	35.1	35.1	35.1	34.9	34.9	34.9
on LBDR, km	25.2	25.2	25.2	25.2	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4	27.4

Source: Statistical Yearbooks of the RM for 1994 (page 319), 1999 (page 382), 2006 (page 405), 2012 (page. 400), 2014 (page 397) and 2016 (page 534); Statistical Yearbooks of the ATULBD for 2000 (page 127), 2006 (page 121), 2009 (page 119), 2010 (page 123), 2012 (page 128), 2014 (page 117), 2016 (page 124).

Table1-41: Railway Transport Means Existent by the end of the year in the RM, 1990-2016, units

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diesel Locomotives	324	256	231	198	180	172	162	162	160	159	156	156
Diesel Trains (Sections)	15446	14579	13796	13308	12691	11471	11037	10473	9763	9175	8944	8758
Cargo Wagons	14960	14097	13316	12838	12233	11010	10577	10033	9303	8723	8492	8318
Passenger Coaches	486	482	480	470	458	461	460	440	460	452	452	440
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Diesel Locomotives	154	154	152	152	152	150	139	138	138	138	138	-57.4
Diesel Trains (Sections)	8613	8356	8319	8342	8246	8005	7832	7423	7247	7247	7087	-54.1
Cargo Wagons	8177	7940	7921	7919	7835	7606	7433	7035	6866	6866	6741	-54.9
Passenger Coaches	436	416	398	423	411	399	399	388	381	381	346	-28.8

Source: Official Letter from SE „Railways Moldova" dated 26.03.1999, No. 94/T, dated17.12.2003 No. H-4/993 and dated 19.09.2006 No. Nteh /338; Letter dated 28.02.2011, No. 54/Nteh, answer to Request No. 03-07/175 dated 02.02.2011; Letter dated 17.01.2014 No.. H-4/147, answer to Request No. 02/9-6-206 dated 03.01.2014; Letter dated 02.03.2015 No. H-4/458, answer to Request No. 407/2015-01-09 dated 29.01.2015; Letter dated 02.06.2016 No. H-4/1186, answer to Request No. 512/2016-05-01 dated 10.05.2016.

Table 1-42: Goods Transportation, by Types of Public Transport in the RM, 1990-2016

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Transported goods, million t												
Transport – total, of which by:	**331.1**	**54.2**	**45.5**	**45.5**	**38.7**	**28.0**	**28.9**	**27.8**	**31.8**	**34.3**	**34.7**	**36.4**
Railway transport, mill. tons	65.4	13.1	12.5	12.8	11.1	6.6	8.2	10.6	12.6	14.7	13.3	11.7
Road transportation, mill. tons	262.8	41.0	33.0	32.7	27.6	21.4	20.7	17.2	19.1	19.5	21.3	24.6
River navigation, kt	2885.5	19.7	19.7	39.1	13.1	15.9	30.8	103.7	107.5	120.0	119.7	111.8
Air transportation, kt	12.2	1.6	1.2	1.2	1.5	1.3	1.4	1.7	0.9	0.8	0.7	0.8
Turnover of goods, million t-km												
Transport – total, of which by:	**21648**	**4296**	**3891**	**3968**	**3597**	**2267**	**2605**	**3044**	**4007**	**4598**	**5169**	**5460**
Railway transport, mill. tons	15007	3134	2897	2937	2575	1191	1513	1980	2748	3019	3006	3053
Road transportation, mill. tons	6305	1160	993	1028	1018	1073	1088	1060	1257	1577	2161	2405
River navigation, kt	317	0.2	0.2	0.3	0.0	0.2	0.1	2.6	0.3	0.3	0.4	0.4
Air transportation, kt	19	2.8	1.5	2.4	3.6	3.3	4.1	2.0	1.3	0.9	1.0	1.0
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Transported goods, million t												
Transport – total, of which by:	**38.3**	**40.8**	**39.8**	**26.0**	**27.8**	**30.7**	**30.0**	**35.7**	**37.1**	**36.7**	**37.0**	**-88.8**
Railway transport, mill. tons	11.1	11.8	11.0	4.4	3.9	4.6	4.2	5.4	5.0	4.2	3.5	-94.7
Road transportation, mill. tons	27.0	28.8	28.6	21.4	23.8	26.0	25.7	30.1	31.9	32.4	33.4	-87.3
River navigation, kt	141.5	166.5	202.0	182.0	127.2	149.1	144.2	162.6	227.2	152.0	135.6	-95.3
Air transportation, kt	1.0	1.0	0.8	0.8	1.3	1.6	1.6	1.3	0.8	0.6	0.5	-95.9
Turnover of goods, million t-km												
Transport – total, of which by:	**6242**	**5865**	**5841**	**3774**	**4193**	**4796**	**4916**	**5652**	**5490**	**5182**	**5484**	**-74.7**
Railway transport, mill. tons	3673	3120	2873	1058	959	1196	960	1227	1181	964	790	-94.7
Road transportation, mill. tons	2567	2743	2966	2714	3232	3597	3955	4423	4307	4217	4693	-25.6
River navigation, kt	0.6	0.6	0.8	0.6	0.4	0.5	0.4	0.5	0.8	0.4	0.3	-99.9
Air transportation, kt	1.3	1.3	1.2	1.1	1.7	1.7	1.7	1.1	1.0	0.8	0.7	-96.3

Source: Statistical Yearbooks of the RM for 2014 (page 390), 2012 (page 393), 2009 (page 387), 2007 (page 395) and 1999 (page 385).

Around 2.3 million passengers used railway transportation services, which is 89.3 per cent less than in 1990, and 30.9 per cent less than in 2015 (Table 1-43).

Table 1-43: Passenger Transportation by Types of Public Transport in the RM, 1990-2016

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Passengers transported, million passengers												
Transport – total, of which by:	**757.7**	**410.9**	**373.5**	**337.5**	**384.7**	**406.1**	**326.7**	**211.5**	**280.6**	**296.3**	**306.9**	**316.4**
Railway transport	21.1	11.7	10.4	10.3	9.4	5.4	4.8	4.8	5.1	5.3	5.1	5.0
Buses	446.9	84.0	77.8	65.6	71.7	65.5	72.4	72.7	83.9	93.4	99.3	105.7
Taxi	13.7	0.7	0.5	0.4	0.3	0.3	0.7	0.7	0.6	0.7	1.1	1.0
Trolley-buses	272.6	314.2	284.6	260.9	303.1	334.6	248.4	133.0	190.7	196.5	201.0	204.3
River transport	2.5	–	–	–	–	–	0.0	0.1	0.1	0.1	0.1	0.1
Air transport	0.9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.4
Passenger turnover, million passenger-km												
Transport – total, of which by:	**10102**	**3605**	**3296**	**3059**	**3013**	**2675**	**2415**	**2131**	**2624**	**2963**	**3347**	**3549**
Railway transport	1626	1019	882	789	656	343	315	325	355	352	346	355
Buses	4878	1163	1195	1071	1067	1013	1021	1069	1298	1640	1949	2059
Taxi	164	15	11	7	6	6	12	12	11	13	20	19
Trolley-buses	1063	1103	914	838	969	1074	815	435	636	654	667	676
River transport	19	–	–	–	–	–	0.1	0.2	0.2	0.3	0.4	0.3
Air transport	2352	305	294	354	315	239	253	290	324	304	365	440
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Passengers transported, million passengers												
Transport – total, of which by:	**318.1**	**319.1**	**326.1**	**291.8**	**232.5**	**237.1**	**240.4**	**240.9**	**241.5**	**249.5**	**252.0**	**-66.7**
Railway transport	5.3	5.6	5.8	5.2	5.0	4.7	4.3	4.1	3.8	3.3	2.3	-89.3
Buses	109.4	103.2	110.3	105.8	106.0	115.3	118.1	118.4	112.6	103.5	106.0	-76.3
Taxi	1.1	3.4	4.3	3.8	4.3	4.1	3.7	3.8	3.0	5.0	4.7	-65.3
Trolley-buses	201.9	206.3	205.2	176.4	116.5	112.2	113.4	113.8	121.0	136.6	137.7	-49.5
River transport	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-94.5
Air transport	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.7	0.9	1.1	1.1	25.4
Passenger turnover, million passenger-km												
Transport – total, of which by:	**3794**	**4187**	**4430**	**3933**	**3993**	**4350**	**4472**	**4694**	**4785**	**5160**	**5397**	**-46.6**
Railway transport	471	468	486	423	399	363	347	330	257	181	122	-92.5
Buses	2206	2476	2599	2300	2417	2733	2836	3124	2874	2922	3106	-36.3
Taxi	20	66	84	73	80	81	75	76	63	101	102	-37.7
Trolley-buses	615	628	623	533	347	335	340	342	367	413	416	-60.9
River transport	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.3	0.3	0.3	-98.4
Air transport	481	550	638	604	751	837	875	822	1225	1543	1651	-29.8

Source: Statistical Yearbooks of the RM for 2016 (page 531), 2014 (page 395), 2012 (page 398), 2009 (page 392), 2007 (page 401) and 1999 (page 389).

River Navigation. RM's river navigation is in the process of development after a long period of stagnation (freight transportation along the Dniester, suspended for above 10 years, was resumed starting in 2000). Currently, operating ports are located in Bender, Dnestrovsk, Malovata and Rabnita on Dniester River, Ungheni on Prut River and Giurgiulesti on the Danube, the latter providing access to the Black Sea. The current length of navigable waterways of public use in the RM is around 624 km (558 km on the right bank of the Dniester and 66 km on the left bank of the Dniester).

The number of river transport means used in the RM for both passenger and cargo transportation on Danube, Dniester and Prut, especially in the warm season, is relatively small (Tables 1-44 and 1-45).

Table 1-44: River Transport Means Existent by the end of the year on the Right Bank of Dniester River, 1990-2016, units

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Goods Self-Propelled Ships	14	9	5	5	5	5	5	4	4	3	-	-	-	-
Goods Non-Self-Propelled Ships	72	67	67	67	20	20	15	15	15	15	15	15	15	15
Towboats, Stamps & Stamp-Towboats	49	48	47	47	12	12	11	11	11	11	11	10	10	10
Passenger Self-Propelled Ships	36	37	32	32	3	3	3	4	3	3	3	3	3	3
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Goods Self-Propelled Ships	-	-	-	-	-	-	-	-	-	-	-	-	-	-100.0
Goods Non-Self-Propelled Ships	15	15	13	12	9	9	9	9	9	9	9	9	9	-87.5
Towboats, Stamps & Stamp-Towboats	10	10	8	8	8	8	8	8	8	8	8	8	8	-83.7
Passenger Self-Propelled Ships	3	3	2	1	1	1	1	1	1	1	1	1	1	-97.2

Source: Statistical Yearbooks of the RM for 1993 (page 330), 1994 (page 325), 1999 (page 390), 2006 (page 407), 2007 (page 403), 2008 (page 399), 2009 (page 398), 2010 (page 399), 2011 (page 399), 2012 (page 402), 2014 (page 399) and 2016 (page 537).

Table 1-45: River Transport Means Existent by the end of the year on the Left Bank of Dniester River, 1990-2013, units

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Goods Ships including Towboats, Stamps & Stamp-Towboats	73	71	69	67	65	63	59	59	58	57	54	52	52	52
Passenger Ships	33	32	31	30	29	28	25	25	25	25	24	23	23	23
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Goods Ships including Towboats, Stamps & Stamp-Towboats	52	50	45	42	42	42	42	42	42	41	39	39	39	-46.6
Passenger Ships	23	14	8	8	8	8	8	8	9	9	9	7	7	-78.8

Source: Statistical Yearbooks of the ATULBD for 2000 (page 128), 2006 (page 121), 2009 (page 119), 2011 (page 124), 2012 (page 128), 2014 (page 128), 2016 (page 124).

In 2016, the river ships transported 135.6 kt of freight, which is by 95.3 per cent less than in 1990, respectively by 10.8 per cent compared to 2015 (Table 1-42). The number of passengers transported by river transport means was 138.7 thousand persons, which is 94.5 per cent less than in 1990 and by 0.5 per cent less than in 2015 (Table 1-43).

Air Transportation. There are 4 airports in Moldova: in Chisinau, Balti, Cahul and Marculesti, of which only the Chisinau airport offers regular scheduled flights. The airports in Cahul and Marculesti are still in the process of obtaining the required statutory approvals and certificates. The Balti Airport is certified, but it offers only charter flights. In recent years, the aircraft fleet of the Republic of Moldova significantly changed its structure. Before 1997, circa 90 per cent of flights were operated by aircrafts produced in CIS countries, by 2014 their share decreased to 45 per cent. Most aircrafts used today are modern, with low GHG emissions, produced mainly in western countries. Table 1-46 provides information on the number of aircraft in use at the end of each year during 1996-2016. In 2016, 0.5 kt of freights were transported by air, a decrease by 95.9 per cent compared to 1990, respectively by 16.7 per cent compared to the previous year (Table 1-42). The number of passengers using air transport services was 1.1285 million persons, by 25.4 per cent more than in 1990, respectively by 4.0 per cent compared to 2015 (Table 1-43).

Communications. In 2015, the number of shipments of post and telegraph money orders increased in comparison to the previous year (+50.9%), as well as the written correspondence (+5.4 per cent) and postal correspondence (+2.0 per cent). At the same time, there was a decrease in in the number of newspapers and magazines delivered (-28.1 per cent). As of December 31, 2014, in the public telephone network, the number of main phone sets exceeded 1219.3 thousand units (1222.7 thousand units in 2013), of which 1072.3 thousand were home phone lines (1079.2 thousand in 2013). As of December 31, 2015, the number of public telephone stations was 1057, while the number of subscribers to the mobile telephone network exceeded 4.324 million. At the end of 2015, 15 television stations and 13 radio stations were operating. In recent years, there has been a constant increasing trend in the number of personal computers owned by legal entities, respectively, the number of legal entities with personal computers and web pages (Table 1-47).

Table 1-46: Air Transport Means Existing in the RM by the end of the year, units

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Civil aircrafts for passenger transportation	40	40	32	20	26	21	19	19	20	32	35
Civil aircrafts for goods transportation	9	6	6	5	6	6	7	9	8	7	16
	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**%**
Civil aircrafts for passenger transportation	20	23	24	22	20	19	21	21	7	9	-77.5
Civil aircrafts for goods transportation	3	3	4	3	4	2	2	2	-	3	-66.7

Source: Statistical Yearbooks of the RM for 2004 (page 562), 2006 (page 407), 2008 (page 399), 2010 (page 399), 2012 (page 399), 2014 (page 399), 2016 (page 537).

Table 1-47: Main Indicators for Post Communications and Telecommunications in RM, 2000-2015

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of mailings:																
Written correspondence, million	11.9	17.0	25.2	30.6	34.3	37.3	38.5	38.3	40.8	41.2	41.9	44.8	48.6	50.1	49.3	52.0
Newspapers and magazines, million	19.0	21.2	22.0	22.8	29.5	28.7	28.5	28.7	26.8	25.1	23.8	21.8	20.6	19.4	21.5	15.4
Parcels, thousand	18.0	18.0	21.0	33.0	29.0	23.0	26.0	27.0	36.0	34.0	79.0	174.0	171.0	206.0	246.0	251.0
Money orders by post and telegraph, million	11.3	9.7	8.8	8.0	8.1	8.1	8.2	8.2	8.2	8.4	8.8	9.0	9.1	9.4	8.8	13.4
Number of telephone conversations ensured by means of fixed telephone service:																
Interurban (long-distance), million	117.4	163	195.9	246.7	293.8	340.8	373.3	348.1	294	246.1	212.9	194.3	225.7	220.8	231.8	…
International, million	17.5	18.6	21.4	25.3	30.7	33.1	37.4	49.4	46.2	31.6	26.3	22.7	19.1	16.8	12.3	…
Number of main phone sets in the public telephone network:																
Total, thousand	603.6	655.3	719.3	791.1	863.4	942.2	1018.1	1081.4	1115.8	1139.9	1162.3	1194.7	1207.0	1222.7	1219.3	…
Of which home lines, thousand	513.3	564.6	625.7	695.5	761.5	838.5	957.6	1002.2	1030.6	1025.2	1042.5	1048.1	1045.5	1079.2	1072.3	…
Number of phone sets:																
Public telephone network	1663	1735	1738	1699	1908	1925	2028	1955	1593	1347	1314	1269	1463	1391	1059	1057
Mobile telephone network	110	225	338	476	787	1090	1358	1882	2423	2785	3165	3715	4262	4431	4373	4324
Number of stations, at the end of the year:																
Television	47	50	50	50	76	76	76	94	130	178	15	15	15	15	15	15
Broadcasting	…	…	…	28	30	36	51	55	48	67	11	11	11	13	13	13
Personal computers owned by legal entities:																
Number of computers, total, thousand	…	…	50.1	59.2	71.2	85.1	103.2	116.8	124.8	138.6	161.1	171.9	174.2	191.5	195.3	206.7
Number of computers with Internet access, thousand	…	…	12.7	17.4	23.3	31.3	41.8	52.5	63.5	77.3	98.9	113.1	123.3	141.6	154.3	166.1
Legal entities owning personal computers and web pages:																
Legal entities owning personal computers, thousand	…	…	…	…	…	3.8	5.1	6.0	6.3	7.1	7.5	9.4	9.6	9.6	10.1	10.6
Legal entities owning a web page, thousand	…	…	…	…	0.3	0.5	0.7	1.0	1.1	1.2	1.2	1.7	1.8	1.9	1.9	2.6

Source: Statistical Yearbooks of the RM for 2016 (page 551), 2014 (page 409-411), 2012 (page 411-412), 2009 (page 407- 409) and 2007 (pages 414-417).

1.6.4. Tourism

Currently, tourism accounts for a relatively insignificant share in the national economy. The modest infrastructure in the tourism and low incomes generated by the tourist businesses rates the RM among the countries where tourism is poorly developed. In 2016, the total tourist accommodation capacity of the collective accommodation facilities was 25.2 thousand beds, registering a decrease by 0.3 per cent, compared to the previous year (Table 1-48).

In the total tourist accommodation capacity, hotels and motels account for 38.1 per cent, holiday villages and other holiday facilities – for 24.2 per cent, summer camps for children –23.0 per cent, tourist and agro-tourist boarding houses – 10.3 per cent, health homes – 3.2 per cent, hostels for visitors – 1.2 per cent.

In 2016, the services of the collective tourist accommodation facilities were used by 306.3 thousand tourists, of which 185.0 thousand were Moldovan tourists (60.4 per cent of the total) and 121.3 thousand tourists were foreign nationals (39.6 per cent). Compared to 2015, the number of tourists in the collective accommodation facilities in the collective accommodation facilities increased (+9.8 per cent), due to the increase use of tourist and agro-tourist boarding houses (by 2.3 times), hotels and motels (+21.8 per cent). At the same time, a decrease was recorded in tourist use of holiday facilities (-14.4 per cent), hostels for visitors (-13.2 per cent), summer camps for children (-10.4 per cent), health homes (-0.1 per cent).

The countries accounting for the highest share in the total number of foreign tourists using the services of the

Table 1-48: Main Indicators for Collective Tourist Accommodation in the RM, 2004-2016

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Accommodation facilities– total, including:	**184**	**191**	**211**	**222**	**229**	**249**	**250**	**247**	**257**	**264**	**275**	**249**	**252**
Hotels and motels	53	54	55	58	62	72	75	85	87	94	100	96	96
Tourist and agro-tourist boarding houses	5	7	12	13	11	15	13	15	19	19	24	26	26
Hostels for visitors	11	10	9	7	6	6	7	6	6	6	5	4	3
Health homes	7	7	6	7	6	6	6	7	7	7	7	7	8
Holiday villages and other holiday facilities	55	57	60	60	62	71	72	63	62	63	63	57	61
Summer camps for children	53	56	69	77	82	79	77	71	76	75	76	59	58
Rooms - total	7.296	7.374	7.970	7.960	8.149	8.349	8.417	8.172	8.308	8.385	8.529	7.735	7.854
Beds – total, thousand	**23.8**	**24.0**	**27.3**	**27.6**	**28.3**	**28.4**	**28.4**	**27.5**	**27.9**	**28.1**	**28.5**	**25.3**	**25.2**
Tourist serviced – total, thousand	286.7	301.7	312.0	314.6	280.6	227.9	229.9	248.3	268.2	271.5	283.0	278.9	306.3
including foreign tourists, thousand	68.8	67.2	62.8	70.3	73.3	59.6	63.6	75.0	89.0	95.6	93.9	94.4	121.3
Man-nights spent during the year - total, thousand	1487.6	1618.6	1753.0	1745.2	1726.9	1400.1	1412.2	1424.4	1462.4	1478.8	1514.3	1505.1	1480.0
including foreign tourists, thousand	174.4	186.6	214.0	201.0	201.6	147.8	162.8	173.9	190.8	216.1	217.9	252.9	246.5
Accommodation capacity utilization rate, %	**37.9**	**43.0**	**44.5**	**44.3**	**46.7**	**36.8**	**32.7**	**32.2**	**30.7**	**34.0**	**35.5**	**35.6**	**34.3**

Source: Statistical Yearbooks of the RM for 2012 (pages 240-245), 2014 (pages 235-242), 2016 (pages 324-334).

accommodation facilities were: Romania (24.6 per cent), Ukraine (13.5 per cent), Russian Federation (8.0 per cent), USA (6.6 per cent), Germany (4.6 per cent), Italy (4.2 per cent), Turkey (3.7 per cent), United Kingdom (3.2 per cent), Poland (2.9 per cent), France (2.1 per cent), Israel (2.0 per cent), Bulgaria and Netherlands (1.5 per cent), Austria (1.4 per cent), Sweden (1.0 per cent), Belarus, Spain and the Czech Republic (0.9 per cent).

The total number of man-nights spent by the tourists in the collective accommodation facilities in 2016 was 1480.4 thousand, by 1.7 per cent les as compared to 2015. This decrease is due to the decreasing number of summer camps for children (-11.9 per cent), health homes (-2.6 per cent), hotels and motels (-1.5 per cent), hostels for visitors (-1.3 per cent). Of the total number of tourists using the services of the accommodation facilities, 83.3 per cent are Moldovans and 16.7 per cent – foreign tourists.

In 2016, the average stay time of a tourist in the collective accommodation facilities represented 5.8 days, of which 7.7 days – for Moldovan tourists and 3.0 days – for foreign tourists. In 2016, the net use of accommodation facilities by type from the total represented 34.3 per cent, including hotels and motels – 19.4 per cent, hostels for visitors – 57.2 per cent, tourist and agro-tourist boarding houses – 16.1 per cent, health homes – 72.6 per cent, holiday facilities – 20.7 per cent, summer camps for children – 42.3 per cent.

Compared to 2015, in 2016 the number of hotels and other similar facilities decreased (by 0.8 per cent), while increasing the accommodation capacity (by 5.8 per cent) and the accommodation capacity utilization rate – by 6.1 per cent (Table 1-49).

Table 1-49: Hotels and Similar Facilities in the RM, as of December 31, 2004-2016

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Hotels and similar facilities - total, including:	**69**	**71**	**76**	**78**	**79**	**93**	**95**	**106**	**112**	**119**	**129**	**126**	**125**
4-5 stars	6	6	10	11	10	13	14	21	24	25	26	28	30
3 stars	4	5	11	11	12	20	22	21	26	32	35	34	32
2 stars	6	7	7	6	8	9	9	9	9	10	12	11	10
1 stars	2	2	3	4	3	4	2	2	2	2	5	5	5
Rooms – total	2576	2475	2457	2297	2350	2517	2695	2864	2996	3053	3205	3146	3250
Accommodation capacity – total beds	**4850**	**4581**	**4519**	**4271**	**4415**	**4727**	**5112**	**5454**	**5667**	**5811**	**6152**	**6072**	**6427**
Man-nights spent during the year - total, thousand	404.1	434.8	483.7	428.0	416.9	330.2	371.7	368.4	381.7	409.1	415.0	435.7	440.2
Accommodation capacity utilization rate %	**25.2**	**26.6**	**30.9**	**28.3**	**28.6**	**20.8**	**22.1**	**20.0**	**20.5**	**21.2**	**21.7**	**21.4**	**22.7**

Source: Statistical Yearbooks of the RM for 2012 (pages 240-245), 2014 (pages 235-242), 2016 (pages 325).

Between 2009 and 2010, the number of foreign tourists visiting the RM decreased, but this pattern did not persisted and soon exceeded the numbers recorded before the beginning of the economic crisis in 2009, because both the infrastructure and the offered tourist destinations are developing rapidly.

In 2016, travel agencies and tour operators provided their services to 234.2 thousand of tourists and excursionists, by 3.4 per cent less than in 2015. The decrease was conditioned by a decrease of the emitting tourism (-6.6 per cent). At the same time, their number increased in domestic tourism (+10.8 per cent) and receiving tourism (+1.0 per cent).

The total number of foreign tourists and excursionists, who visited the RM and used the services of the Moldovan travel agencies and tour operators in 2016 was 15.7 thousand (Table 1-50), of which 73.1 per cent arrived aiming to rest, for recreation and leisure, 19.5 per cent - for business and professional purpose and 3.9 per cent - for a treatment. In 2016, the total number of Moldovan tourists and excursionists, who travelled abroad using the services of the Moldovan travel agencies and tour operators was 177.3 thousand (Table 1-50), by 6.6 per cent less compared to 2015. Most of them travelled to rest, for recreation and leisure (98.9 per cent). The above statistics reflect only the trips arranged by the Moldovan travel agencies and tour operators and do not include trips arranged by the travelers personally.

In 2016, the number of crossings of the state border by foreign citizens at the entry into the country accounted for 3.4 million, by 18.9 per cent more than in 2015. The countries accounting for the highest share in the total number of foreign citizens crossings the state border were Romania (54.9 per cent), Ukraine (28.7 per cent), Russian Federation (7.3 per cent), Bulgaria (1.6 per cent), Italy (1.0 per cent), Germany (0.7 per cent), Turkey and Israel (.6 per cent), USA (0.5 per cent), Belarus and Poland (0.4 per cent), Portugal (0.3 per cent). Foreign citizens preferred to travel by car (84.0 per cent of the total number of crossings), air (14.3 per cent) and by train (1.7 per cent). In 2016, the number of crossings of the state border by Moldovan citizens, exiting the country, represented 5.8 million, by 3.6 per cent more than in 2015. Road transportation means were most often used for travelling abroad, accounting for 88.1 per cent of the total number of crossings.

1.6.5. Retail Trade and Sales of Personal Services

The 2016 retail sales registered a growing pattern. The population purchased consumer goods to the total amount of 67.8 billion MDL or by 4.1 per cent less as compared to 2015 (Table 1-51). In comparable prices, in 2016, the trading volume for retail trade increased by 1.1 per cent as compared to the preceding year.

Table 1-50: Tourist Activities of the Travel Agencies and Tour Operators in the RM, 2004-2016, thousand

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Number of foreign tourists arrived - total	26.0	25.1	14.2	14.7	8.7	9.2	9.0	10.8	12.8	13.2	14.4	15.5	15.7
Number of Moldovan tourists travelled abroad - total	67.8	57.2	67.8	81.8	85.1	93.3	117.2	136.1	146.8	157.6	180.6	189.8	177.3

Source: Statistical Yearbooks of the RM for 2012 (pages 240-245), 2014 (pages 235-242), 2016 (page 332).

Table 1-51: Retail Trade in the RM, 1990-2017

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Retail sales, billion MDL	6.4	11.0	47.3	0.4	1.4	2.8	3.8	4.0	3.7	3.6	6.0	7.6	10.8	14.5
% compared to the previous year		82.0	53.0	75.0	58.0	111.7	118.0	96.2	87.7	72.6	104.0	114.8	134.2	118.2
Retail sales, billion US$				0.322	0.335	0.613	0.834	0.859	0.685	0.343	0.484	0.591	0.792	1.043
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Retail sales, billion MDL	16.6	19.5	23.4	28.2	34.7	32.1	38.8	50.9	51.8	57.3	62.6	70.7	67.8	73.4
% compared to the previous year	105.6	105.3	106.9	107.6	108.8	95.1	104.5	112.2	103.4	107.2	106.6	99.6	106.0	105.3
Retail sales, billion US$	1.344	1.547	1.779	2.325	3.338	2.892	3.135	4.340	4.277	4.552	4.458	3.758	3.405	3.669

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

In 2016, the trading volume for personal service sales accounted for 27.5 billion MDL or by 8.0 per cent more, in real terms, as compared to 2015 (Table 1-52). In comparable prices, in 2016, the trading volume for personal service sales companies, recorded a positive trend, increasing by 0.6 per cent compared to the previous year.

1.6.5. Capital Investments

The 2016 data on the volumes of capital investments show a decrease compared to 2015 (Figure 1-12). Within 1990-2016 periods, the development of that indicator was characterized by certain fluctuations, positive results were recorded only in 1998 and, more recently, during 2001-2008, 2010-2011 and 2013-2014 years.

In January-December 2016, capital investments totaled 19.4 billion MDL (in current prices) (Table 1-53). Compared to the similar period of the previous year, this index shows a decrease by 13.9 per cent (in comparable prices).

In January-December 2016, investments in material assets by types of fixed assets (in comparable prices) decreased to the similar period of the previous year for residential buildings – by 20.6 per cent; buildings (exclusive residential) and edifices – by 3.9 per cent; machinery, equipment and transmission equipment – by 21.6 per cent; transportation vehicles – by 9.3 per cent. Of the total investments made in January-December 2016, the largest share is represented by investments in

Table 1-52: Sales of Personal Services in the RM, 1990-2017

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Sales of personal services, bill. MDL	0.9	1.2	5.8	0.1	0.4	0.7	0.8	1.2	1.3	1.9	2.6	3.4	4.2	5.3
% compared to the previous year		81.0	55.0	67.0	52.0	100.1	78.1	110.2	88.3	89.8	100.1	121.2	111.8	113.3
Sales of personal services, bill. US$				0.052	0.104	0.145	0.178	0.268	0.242	0.181	0.209	0.265	0.311	0.380
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sales of personal services, bill. MDL	7.0	8.2	10.0	11.6	13.2	14.6	16.7	19.0	20.8	22.0	23.2	25.4	27.5	29.1
% compared to the previous year	105.3	109.2	105.6	101.1	97.8	102.5	103.9	105.0	103.0	103.0	103.0	103.0	103.0	103.0
Sales of personal services, bill. US$	0.565	0.652	0.759	0.953	1.266	1.313	1.348	1.623	1.720	1.748	1.655	1.351	1.379	1.457

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

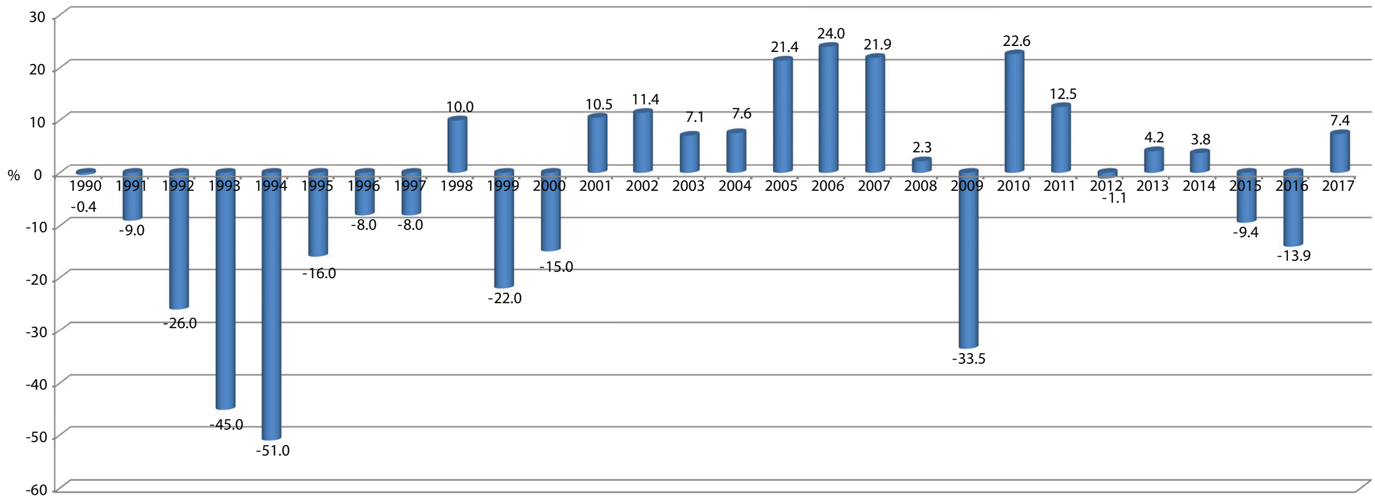


Figure 1-12: Capital Investments in the RM, 1990-2017 (in % compared to the preceding year).

Table 1-53: Capital Investments in the RM, 1990-2017

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Investments, billion MDL	2.5	3.3	28.3	0.2	0.7	0.8	1.0	1.2	1.4	1.6	1.8	2.3	2.8	3.6
% compared to 1990	100.0	91.0	67.3	37.0	18.1	15.2	14.0	12.9	14.2	11.1	9.4	10.4	11.6	12.4
in % compared to the previous year	99.6	91.0	74.0	55.0	49.0	84.0	92.0	92.0	110.0	78.0	85.0	110.5	111.4	107.1
Investments billion US $				0.128	0.175	0.188	0.215	0.260	0.269	0.152	0.142	0.180	0.207	0.260
in % of the GDP	19.2	12.7	14.7	9.4	15.0	13.0	12.7	13.5	15.8	12.9	11.0	12.2	12.4	13.1
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Investments, billion MDL	5.1	7.8	11.0	15.3	18.2	11.1	13.8	16.4	17.2	19.1	21.2	21.1	19.4	21.3
% compared to 1990	13.3	16.2	20.1	24.5	25.1	16.7	20.4	23.0	22.7	23.7	24.6	22.3	19.2	20.6
in % compared to the previous year	107.6	121.4	124.0	121.9	102.3	66.5	122.6	112.5	98.9	104.2	103.8	90.6	86.1	107.4
Investments billion US $	0.417	0.619	0.839	1.264	1.754	1.001	1.116	1.402	1.417	1.520	1.507	1.122	0.974	1.063
in % of the GDP	16.0	20.7	24.6	28.7	29.0	18.4	19.2	20.0	19.4	19.0	18.9	17.2	14.4	14.3

Source: Ministry of Economy and Infrastructure of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (May 2017).

machinery, equipment and transmission equipment (34.3 per cent), buildings (exclusive residential) and edifices (19.6 per cent), residential buildings (13.3 per cent), transportation vehicles (10.0 per cent) and others (22.8 per cent).

The analysis of the investment structure by ownership revealed that increased investment activity was recorded mainly at the expense of the private sector of the economy, representing 12.594 billion MDL, or 64.9 per cent of the total investments, followed by other sources – 3.493 billion MDL (18.0 per cent), foreign sources – 1.494 billion MDL (7.7 per cent), state budget – 0.932 billion MDL (4.8 per cent), the budget of the administrative-territorial units – 0.893 billion MDL (4.6 per cent).

1.6.6. Forestry Management

According to the national definition, 'forest' is an element of geographical landscape, a functional unit of the biosphere, composed of the totality of forest vegetation (dominated by trees and shrubbery), live layers, animals and microorganisms which are interdependent in their biological development and affect their habitat. Lands covered with forest vegetation occupying areas over 0.25 ha are regarded as forests. The minimal consistency of trees and shrubbery for the lands with forest vegetation to be considered forests should reach an operational level of 30 per cent. The consistency requirement should apply only to trees and shrubbery with a natural potential to reach a minimum height of 5 meters at maturity.

In the Republic of Moldova, the areas covered with forests varied considerably over time, from 366.2 thousand ha in 1848 to 222.0 thousand ha in 1945[13], recovering to 386.4 thousand ha in 2015 or circa 11.4per cent of the country's territory (Figure 1-13).

The respective indicator is significantly below the European average (circa 30 per cent). According to the scientific research studies, the current areas covered with forests are obviously insufficient to meet the ecological and social-economic needs of the Republic of Moldova. In order to ensure a constant ecological equilibrium and a stronger effect on the climate and hydrological conditions, enhance productivity of agricultural lands, forest lands should occupy at least 15 per cent of the country's territory. The dispersion and fragmentation of forest resources, their uneven distribution across the country represent negative aspects for exercising beneficial eco-protective influences on the environment, creating comfortable living conditions for the population and providing wood and non-wood products.

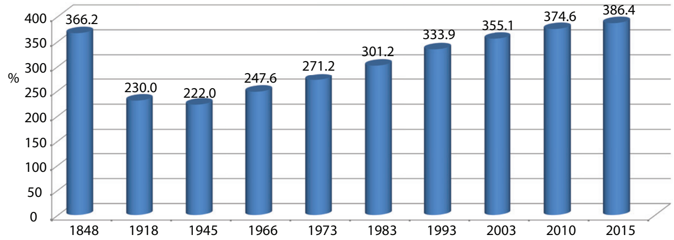


Figure 1-13: Evolution of Areas Covered with Forests in the RM, 1848-2015, thousand ha.

The total volume of standing wood mass in the forests of the Republic of Moldova is circa 45.4 million m^3, on average 118 m^3 per hectare. The average forest increment is 3.8 m^3/yr/ha, and the total average increment is circa 1468.3 thousand m^3/yr. The average production class is 3.9 (Table 1-54).

The structure by age in all forest species[14] is misbalanced, in particular in those of low productivity. In conformity with Article 14 of the Forest Code, the forests in the Republic of Moldova are included in the functional group I, having exclusively environment protection functions.

In terms of functions, there are 5 functional sub-groups: forests with water protection functions – 1.6 per cent; forests with lands and soils protection functions – 6.7 per cent;

[13] Gh. Vdovîi, D. Galupa et al. (1997), National Report on the Conditions of the Forest Resources of Republic of Moldova, Galupa D., Talmaci I., Spitoc L. (2006), Forest Land Sector in the Republic of Moldova – issues, accomplishments, perspectives; Galupa Dumitru, Platon Ion et al. (2011), Report on the Conditions of the Forest Resources of Republic of Moldova: 2006-2010. 'Moldsilva' Agency; Ch., 48 p.; Official Monitor No. 265-276 dated 19.08.2016, art. No. 1054: Government Decision Nor. 971 dated 12.08.2016 on the approval of Land Cadaster of the RM as of January 1, 2016.

[14] Abbreviations used in Table 1-54: Quercus spp. – QU; Quercus petraea – GO; Quercus pubescens – STP; Populus spp.– PO; Salix spp. – SA; Acer platanoides – PA; Fraxinus spp. – FR; Tilia spp. – TI; Carpinus spp – CA; Juglans spp. – NU; Ulmus spp. – UL; Robinia spp – RB; Various resinous species – DR, Various softwoods – DM; Various hardwoods – DT; Various exotic species – EX.

Table 1-54: The General Structure of Forest Fund in the Republic of Moldova

Structure Elements	Total / average	Species							
		QU	GO	STP	PLA	SA	PA	FR	TE
Area, ha	386395.4	57152.1	46289.2	7240.8	5071.2	4707.1	6859.1	30290.6	13666.8
Proportions of above-ground species, %	100.0	14.8	12.0	1.9	1.3	1.2	1.8	7.8	3.5
Average production class	3.9	3.6	2.8	3.0	3.1	4.0	3.7	3.4	3.1
Average consistency	0.76	0.75	0.76	0.73	0.75	0.66	0.76	0.77	0.78
Average age, year	45	68	79	79	38	35	35	60	67
Current growth, m^3/yr/ha	3.8	4.2	3.9	0.9	5.6	6.5	2.3	4.4	6.4
Annual growth, m^3	1457791	241111	178467	6875	28262	30540	16046	134292	87863
Average volume per standing wood, m^3/ha	118	184	234	119	174	106	90	195	238
Forest fund per standing wood, m^3	45407785	10536945	10843035	863755	881432	498840	615719	5909773	3256044
Proportion of species per volume, %	100.0	23.2	23.9	1.9	1.9	1.1	1.3	13.0	7.2
Structure Elements	**Total / average**	**Species**							
		CA	**ULC**	**NU**	**SC**	**DR**	**DM**	**DT**	**EX**
Area, ha	386395.4	20576.9	6261.9	11762.7	127902.7	6033.0	3886.9	38257.4	437.0
Proportions of above-ground species, %	100.0	5.3	1.6	3.1	33.1	1.6	1.0	9.9	0.1
Average production class	3.9	3.6	4.4	4.8	4.6	3.9	3.7	4.1	4.5
Average consistency	0.76	0.79	0.68	0.63	0.77	0.69	0.67	0.72	0.74
Average age, year	45	60	28	34	17	34	33	37	28
Current growth, m^3/yr/ha	3.8	5.0	2.9	2.7	3.2	4.7	4.6	3.1	2.6
Annual growth, m^3	1457791	102138	17927	32332	414757	28455	18012	119572	1142
Average volume per standing wood, m^3/ha	118	152	62	34	30	89	116	84	70
Forest fund per standing wood, m^3	45407785	3131245	386897	403949	3841412	534891	450882	3222509	30457
Proportion of species per volume, %	100.0	6.9	0.8	0.9	8.5	1.2	1.0	7.1	0.1

forests with protection functions against harmful climatic and industrial factors– 48.6 per cent; forests with recreational functions – 29.5 per cent; forests presenting scientific interest and for protection of forestry genetic and ecological pool – 13.6 per cent.

In spring-summer of 2007, a catastrophic drought has been reported, affecting over 80 per cent of the country's territory. This phenomenon has significantly damaged the national forests on an area of circa 19 thousand ha or 5.5 per cent of the forest fund area, in particular the southern and central regions of the country.

The respective drought affected about 20 indigenous as well as non-native forest species, including: pedunculate oak (*Quercus robur L.*), sessile oak (*Quercus petraea (Matt) Liebl.*), pubescent oak (*Quercus pubescens Willd*), ash tree (*Fraxinus exelsior L.*), field maple (*Acer platanoides L.*), mountain maple (*Acer pseudoplatanus L.*), acacia (*Robinia pseudoacacia L.*), white birch (*Betula verrucosa Ehrh.*), pine silvestre (*Pinus sylvestris L.*), Crimeea black pine (*Pinus pallasiana (Lamb) Holmboe*). The most affected were acacia, representing 71.3 per cent (13 thousand ha) of the total forest area affected. The 2007 drought has long-lasting consequences, visible over many years. In 2009, according to the forestry-pathological survey data, the total area of degraded and dried in different intensity trees accounted for 17.9 thousand ha, in 2010 – 13.1 thousand ha, in 2011 – 8.9 thousand ha, while in 2012 – 9.0 thousand ha.

The diversity of forest species growing in the forests of the RM is presented in Table 1-55, forming eleven large groups of species.

In order to estimate biomass increments in forests and implicitly, resulting in CO_2 removals, there were used data on the areas of forest land in the Republic of Moldova, in the time series from 1990 through 2015, available into the National Report on Forestry Resources of the Republic of Moldova (2011), Report on Forest Land and activity results of "Moldsilva" Agency within 1990-2015 periods and General Land Cadasters of the Republic of Moldova (Table 1-56).

At the same time, beginning with 2013, information on the distribution of predominant forest species were taken from Forestry Research and Management Institute (ICAS) database.

Table 1-55: Groups of Forest Species and their Structure in the Republic of Moldova

No.	Groups of species by name		Species included in categories	Abbreviations
	Scientific	Common		
	Quercus spp.	Oak tree	Ilex, durmast, oak, red oak	QU
	Carpinus ssp.	Hornbeam	Hornbeam (*Carpinus betulus*)	CA
	Fraxinus spp.	Ash tree	Ash tree	FR
	Acer spp.	Sycamore maple	Field maple, Common maple, Mountain maple	AC
	Ulmus spp.	Elm	Field elm, Elm tree, Turkestan elm, etc.	UL
	Tilia spp.	Linden tree	Foul lime, Silver lime, big leaf linden tree	TI
	Salix spp.	Willow	Willow, Osier, etc.	SA
	Pinus spp.	Pine	Pine silvestre, Black pine, Spruce fir, Fir tree	PI
	Populus spp.	Poplar	Trembling poplar, Black poplar, Aspen tree	PO
	Robinia spp.	Acacia	Acacia, Honey locust, Sofora	RB
	Other species	Other species	Apple tree, Peer, Sweet cherry tree, Sour cherry tree magaleb, Apricot tree, sycamore, Weeping willow, Hazel tree, Corneal tree, Hawthorn, Sweet briar, Female cornel, etc.	OS

Table 1-56: Forest Land Areas in the Republic of Moldova within 1990-2015 periods, thousand ha

Year	Total	Forest Land Areas by Species										
		QU	CA	FR	AC	UL	TI	SA	PI	PO	RB	OS
1990	325.4	140.6	9.4	16.6	2.9	3.1	2.9	1.9	6.9	5.7	124.0	11.4
1991	328.2	141.3	9.4	16.7	2.9	3.1	2.9	2.0	6.9	5.9	125.7	11.4
1992	331.0	142.0	9.4	16.8	3.0	3.1	2.9	2.1	6.9	6.0	127.4	11.4
1993	333.9	142.7	9.5	16.9	3.0	3.1	2.9	2.2	6.9	6.1	129.1	11.5
1994	335.4	143.1	9.9	17.2	3.0	3.1	2.9	2.2	6.9	6.2	130.0	10.9
1995	336.9	143.5	10.2	17.6	3.0	3.1	2.9	2.3	6.9	6.2	130.9	10.4
1996	338.4	143.8	10.6	17.9	3.0	3.1	2.9	2.3	6.9	6.3	131.7	9.8
1997	339.9	144.2	11.0	18.2	3.0	3.1	2.9	2.4	6.9	6.3	132.6	9.3
1998	341.4	144.6	11.3	18.6	3.0	3.1	2.9	2.4	6.9	6.4	133.5	8.7
1999	342.9	145.0	11.7	18.9	3.0	3.1	2.9	2.5	6.9	6.5	134.4	8.1
2000	344.4	145.3	12.1	19.2	3.0	3.1	2.9	2.5	6.9	6.5	135.3	7.6
2001	345.9	145.7	12.4	19.6	3.0	3.1	2.9	2.6	6.9	6.6	136.1	7.0
2002	347.3	146.0	12.8	19.9	3.0	3.1	2.9	2.6	6.9	6.6	137.0	6.4
2003	352.4	148.4	12.6	20.1	3.2	3.2	3.1	2.5	6.9	6.7	137.9	7.8
2004	357.6	151.7	12.4	20.2	3.4	3.4	3.2	2.4	6.9	6.8	138.8	8.4
2005	362.7	153.6	12.1	20.3	3.7	3.8	3.4	2.4	7.0	6.9	139.7	9.8
2006	366.0	153.9	12.1	20.5	4.0	3.8	3.4	2.4	7.0	7.0	141.9	10.0
2007	369.0	154.2	11.8	20.7	4.1	3.9	3.5	2.4	7.0	7.0	144.4	10.0
2008	372.0	154.7	11.9	20.8	4.1	3.9	3.5	2.4	6.9	7.1	146.7	10.0
2009	372.9	155.1	12.1	20.9	4.1	3.9	3.5	2.4	6.9	7.1	146.9	10.0
2010	374.5	155.4	12.1	21.0	4.1	3.9	3.5	2.4	6.9	7.1	148.0	10.1
2011	374.8	155.6	12.1	21.0	4.1	3.9	3.5	2.4	6.9	7.1	148.1	10.1
2012	375.3	155.8	12.1	21.0	4.1	3.9	3.5	2.4	6.9	7.1	148.3	10.1
2013	372.8	154.7	12.0	20.9	4.1	3.9	3.5	2.4	6.8	7.1	147.3	10.1
2014	379.3	167.1	16.4	21.8	5.7	4.1	5.7	3.9	6.3	7.5	125.6	15.1
2015	386.4	170.3	16.7	22.2	5.8	4.2	5.8	4.0	6.4	7.7	128.0	15.4

Source: National Report on Forestry Resources of the Republic of Moldova (2011), General Land Cadasters for 1990-2015 periods; Statistical Records and Reports of "Moldsilva" Agency on afforestation over the 1998-2015 periods.

Table 1-57: Forest land areas remaining forest land in the RM within 1990-2015 periods, kha

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998
QU	98.38	99.94	104.34	108.15	111.26	113.97	117.15	119.18	121.17
CA	6.58	6.65	6.91	7.20	7.67	8.13	8.63	9.06	9.50
FR	11.61	11.81	12.34	12.81	13.40	13.96	14.58	15.07	15.56
AC	2.03	2.05	2.20	2.27	2.33	2.38	2.44	2.48	2.51
UL	2.17	2.21	2.28	2.35	2.41	2.46	2.52	2.56	2.60
TI	2.03	2.05	2.13	2.20	2.26	2.30	2.36	2.40	2.43
SA	1.33	1.41	1.54	1.67	1.75	1.82	1.90	1.97	2.03
PI	4.83	4.88	5.07	5.23	5.37	5.48	5.62	5.70	5.78
PO	3.99	4.17	4.41	4.62	4.79	4.94	5.12	5.24	5.36
RB	86.76	88.91	93.61	97.84	101.07	103.97	107.30	109.61	111.88
OS	7.98	8.06	8.38	8.72	8.48	8.26	7.98	7.69	7.29
Grooves	32.19	32.30	30.71	30.16	27.79	26.13	25.68	26.00	26.91
Total	259.86	264.46	273.92	283.22	288.57	293.81	301.29	306.95	313.02
Species	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
QU	123.99	127.38	128.91	128.69	128.94	131.14	132.40	131.17	130.82
CA	10.00	10.57	11.00	11.28	10.95	10.72	10.43	10.31	10.01
FR	16.17	16.86	17.31	17.54	17.46	17.46	17.50	17.47	17.56
AC	2.57	2.63	2.65	2.64	2.78	2.94	3.19	3.41	3.48
UL	2.65	2.72	2.74	2.73	2.78	2.94	3.28	3.24	3.31
TI	2.48	2.54	2.57	2.56	2.69	2.77	2.93	2.90	2.97
SA	2.11	2.20	2.27	2.30	2.17	2.07	2.07	2.05	2.04
PI	5.90	6.05	6.11	6.08	6.00	5.96	6.03	5.97	5.94
PO	5.53	5.71	5.82	5.85	5.82	5.88	5.95	5.97	5.94
RB	114.95	118.56	120.45	120.77	119.82	119.97	120.38	120.94	122.51
OS	6.93	6.66	6.19	5.64	6.78	7.26	8.45	8.52	8.48
Grooves	24.76	24.44	24.60	25.09	27.90	27.93	25.97	28.83	30.29
Total	318.03	326.32	330.62	331.18	334.09	337.04	338.56	340.76	343.35
Species	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
QU	131.06	131.25	132.87	133.67	133.80	132.33	143.76	146.44	48.9
CA	10.08	10.24	10.35	10.41	10.41	10.30	14.06	14.33	117.8
FR	17.62	17.69	17.96	18.05	18.07	17.87	18.71	19.06	64.2
AC	3.47	3.47	3.51	3.52	3.53	3.49	4.92	5.01	146.8
UL	3.30	3.30	3.33	3.35	3.36	3.34	3.56	3.63	67.3
TI	2.97	2.96	2.99	3.01	3.01	2.98	4.90	5.00	146.3
SA	2.03	2.03	2.05	2.06	2.06	2.05	3.36	3.42	157.1
PI	5.85	5.84	5.90	5.93	5.93	5.82	5.43	5.53	14.5
PO	6.01	6.01	6.07	6.10	6.11	6.08	6.47	6.59	65.2
RB	124.28	124.31	126.54	127.25	127.36	125.97	108.06	110.08	26.9
OS	8.47	8.46	8.64	8.69	8.69	8.59	13.15	13.25	66.0
Grooves	30.25	34.55	33.46	30.89	31.73	36.15	29.23	23.83	-26.0
Total	345.40	350.10	353.66	352.93	354.07	354.97	355.62	356.17	37.1

Source: General Land Cadasters for 1990-2015 periods; Land Use and Land Use-Change Matrix for 1970-2015 periods.

Final data on species distribution over the period of time under review was obtained by modelling using the primary data set obtained from the Statistical Records and Reports of Agency "Moldsilva", which featured the following distribution of forest species planted over the reference period: *Robinia species* – accounted for circa 80 per cent, *Juglans spp.* (*Regia and Nigra*) – for 8 per cent, *Quercus species* – for 3 per cent, *Populus* and *Salix species* – for 3 per cent, *other species* – for 6 per cent (Table 1-57).

The volume of commercial timber, as well as the quantity of fuel wood gathered in the RM, were identified based on statistical data and reports on commercial fellings in managed forest land (by species and sort categories, etc.), revealed illegal logging (on other owners lands, inclusively), data being provided by the "Moldsilva" Agency, and the State Ecological Inspectorate, on authorized fellings and illegal logging in forests and other woody vegetation areas managed by local public authorities, as well as data available in the Statistical Yearbooks of the ATULBD on fuel wood harvests in forests on the left bank of Dniester river (Table 1-58).

Table 1-58: Trends in Wood Harvests in the RM within 1990-2015 periods, thousand m^3

Sort Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998
Commercial fellings	39.42	27.00	27.39	31.50	39.80	68.49	51.69	52.70	38.00
Fuel wood harvest	184.80	376.50	490.29	489.18	538.70	531.42	450.43	423.85	398.55
Sort Categories	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Commercial fellings	38.79	39.68	37.28	50.41	46.99	43.47	39.01	46.51	44.44
Fuel wood harvest	368.62	393.34	432.47	381.98	420.20	415.37	394.79	430.10	390.92
Sort Categories	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Commercial fellings	42.79	37.34	40.63	33.91	31.69	29.92	25.60	28.00	-29.0
Fuel wood harvest	401.84	396.82	429.89	485.45	541.47	587.20	624.33	607.32	228.6

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2015 time series; D. Galupa, I. Talmaci, L. Spitoc, Study for the Republic of Moldova "Ensuring sustainability of forests and livelihoods through improving governance and control of illegal logging". Chisinau, Editorial Center of UASM, 2005, 116 pages; Statistical Yearbooks of the ATULBD (2000-2016); Galupa Dumitru, Ciobanu Anatol, Scobioala Marian et al. (2011), Illegal logging of forest vegetation in the Republic of Moldova. Analytical study, Chisinau, "Moldsilva" Agency, 38 pages.

The "Moldsilva" Agency keeps records of harvested wood by species (except for some species suitable for industrial processing, ex.: (1) hardwood - oak, durmust, hornbeam, ash tree, sycamore maple tree, elm, acacia, honey locust, etc.; (2) softwood - poplar, willow, linden tree etc. The ratio of the estimated volume by species to total volume harvested per year provided data of acceptable quality (the difference between the estimated volume and harvested volume is on average 5-10 per cent). Distribution by species of wood suitable for industrial processing and fuel wood is presented in Tables 1-59 and 1-60 and refers to the 1990-2015 periods.

Table 1-59: Trends in Commercial Fellings Harvest in the RM within 1990-2015, thousand m³

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998
Quercus spp.	7.16	4.32	4.09	4.41	6.88	9.59	10.05	10.26	7.40
Carpinus spp.	1.05	0.71	0.72	0.83	1.04	1.79	1.35	1.39	1.00
Fraxinus spp.	3.65	2.99	3.24	3.94	4.03	8.56	4.47	4.47	3.23
Acer spp.	0.31	0.23	0.23	0.27	0.34	0.58	0.45	0.44	0.32
Ulmus spp.	0.17	0.1	0.1	0.12	0.15	0.26	0.19	0.21	0.15
Tilia spp.	3.78	2.48	2.52	2.9	3.66	6.31	4.70	4.91	3.54
Salix spp.	0.26	0.19	0.19	0.22	0.28	0.48	0.37	0.36	0.26
Pinus spp.	0.28	0.17	0.18	0.2	0.26	0.44	0.32	0.35	0.25
Populus spp.	4.87	3.2	3.26	3.74	4.73	8.14	6.07	6.33	4.56
Robinia spp.	16.74	12.02	12.26	14.18	17.54	30.83	22.66	22.70	16.37
Other species	1.15	0.59	0.6	0.69	0.89	1.51	1.06	1.28	0.92
Total	39.42	27.00	27.39	31.50	39.80	68.49	51.69	52.70	38.00
Species	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Quercus spp.	7.51	7.77	5.18	10.12	10.31	9.34	7.63	9.26	7.49
Carpinus spp.	0.99	1.07	1.09	1.85	1.00	0.92	1.05	1.28	0.92
Fraxinus spp.	3.49	3.17	2.96	4.45	3.41	3.03	3.12	5.57	5.94
Acer spp.	0.37	0.28	0.30	0.42	0.26	0.19	0.28	0.28	0.28
Ulmus spp.	0.13	0.18	0.19	0.24	0.22	0.22	0.18	0.27	0.31
Tilia spp.	3.34	3.97	4.86	4.82	4.22	4.47	3.90	4.06	3.45
Salix spp.	0.30	0.24	0.32	0.29	0.20	0.21	0.24	0.31	0.42
Pinus spp.	0.22	0.30	0.33	0.00	0.00	1.10	0.30	0.79	1.60
Populus spp.	4.32	5.11	2.89	5.82	8.28	6.62	5.02	7.81	6.44
Robinia spp.	17.67	16.13	18.19	19.94	16.43	15.93	15.85	15.68	16.58
Other species	0.45	1.46	0.97	2.46	2.66	1.44	1.44	1.22	1.01
Total	38.79	39.68	37.28	50.41	46.99	43.47	39.01	46.51	44.44
Species	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Quercus spp.	7.17	5.84	7.16	5.68	4.77	6.28	6.05	6.62	-7.5
Carpinus spp.	1.13	0.77	0.87	0.74	0.49	0.52	0.33	0.36	-65.7
Fraxinus spp.	6.02	5.70	5.83	4.03	4.52	4.76	4.26	4.66	27.7
Acer spp.	0.25	0.15	0.20	0.14	0.11	0.15	0.06	0.06	-80.6
Ulmus spp.	0.20	0.17	0.19	0.24	0.12	0.17	0.06	0.06	-64.7
Tilia spp.	3.84	3.24	3.42	3.17	2.67	2.21	2.00	2.19	-42.1
Salix spp.	0.38	0.38	0.14	0.19	0.24	0.25	0.07	0.08	-69.2
Pinus spp.	0.60	0.89	1.19	1.95	1.35	0.73	0.62	0.68	142.9
Populus spp.	6.09	4.87	6.32	5.61	5.26	5.06	4.69	5.13	5.3
Robinia spp.	16.01	14.34	14.41	11.47	11.69	9.43	7.09	7.76	-53.6
Other species	1.10	0.98	0.89	0.69	0.47	0.36	0.37	0.40	-65.2
Total	42.79	37.34	40.63	33.91	31.69	29.92	25.60	28.00	-29.0

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2015 time-series.

Data on the volume of fuel wood gathered also include the volume of twigs, boughs, branches, etc., which are used as fuel as well. Taking into account that most illegal loggings occur in forests managed by local public authorities, situated near settlements and composed preponderantly of acacia, the respective volumes were attributed to *Robinia* group of species.

Table 1-60: Trends in Fuel Wood Harvest in the RM within 1990-2015 periods, thousand m³

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998
Quercus spp.	30.10	50.35	49.29	51.15	39.07	63.60	58.99	49.12	64.60
Carpinus spp.	12.50	17.96	13.24	13.15	10.05	11.30	15.45	20.41	26.84
Fraxinus spp.	15.80	38.99	56.52	73.07	55.81	71.97	73.74	25.80	33.93
Acer spp.	8.70	11.39	6.65	6.19	4.73	5.30	5.00	14.12	18.57
Ulmus spp.	3.50	6.19	6.54	10.23	7.81	8.76	2.26	5.72	7.52
Tilia spp.	10.60	18.97	20.40	29.23	22.32	20.10	19.50	17.29	22.73
Salix spp.	3.40	6.68	7.95	12.42	9.49	10.64	4.14	5.57	7.33
Pinus spp.	0.40	2.10	4.09	6.58	5.02	5.63	3.80	0.70	0.92
Populus spp.	11.80	34.34	55.04	73.07	55.81	74.35	70.09	19.21	25.26
Robinia spp.	76.80	172.62	256.75	198.01	316.31	246.00	184.48	247.59	166.76
Other species	11.20	16.91	13.82	16.08	12.28	13.77	12.98	18.32	24.09
Total	184.80	376.50	490.29	489.18	538.70	531.42	450.43	423.85	398.55
Species	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Quercus spp.	55.32	53.71	48.34	56.93	65.45	64.16	56.64	71.56	57.00
Carpinus spp.	24.10	23.40	22.46	23.41	23.07	25.30	24.68	27.49	23.70
Fraxinus spp.	30.09	29.22	28.35	28.91	32.38	30.63	30.81	48.42	47.74
Acer spp.	16.64	16.16	14.17	17.49	16.50	17.13	17.04	23.05	21.44
Ulmus spp.	6.38	6.19	5.78	6.36	8.32	7.07	6.53	10.45	10.47
Tilia spp.	19.59	19.02	18.93	18.35	21.63	23.40	20.06	27.66	24.71
Salix spp.	6.32	6.13	5.48	6.55	6.28	8.22	6.47	9.95	8.43
Pinus spp.	0.74	0.72	1.41	0.00	0.00	2.09	0.76	3.06	2.80
Populus spp.	20.32	19.73	17.37	21.29	28.96	28.19	20.80	27.11	23.26
Robinia spp.	168.74	199.28	252.20	181.90	190.09	187.09	190.14	164.27	155.19
Other species	20.38	19.78	17.98	20.79	27.52	22.09	20.86	17.08	16.17
Total	368.62	393.34	432.47	381.98	420.20	415.37	394.79	430.10	390.92
Species	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Quercus spp.	59.84	59.35	65.69	79.64	83.02	98.39	106.84	100.82	235.0
Carpinus spp.	27.73	26.27	30.17	34.86	40.26	43.26	45.93	44.15	253.2
Fraxinus spp.	49.05	52.75	62.33	51.55	63.35	71.66	76.71	74.44	371.1
Acer spp.	23.48	23.33	23.79	22.06	12.98	21.90	17.27	31.63	263.6
Ulmus spp.	8.55	9.90	12.74	20.56	21.48	20.25	19.15	15.12	332.0
Tilia spp.	25.19	22.43	22.98	22.18	28.72	29.86	30.30	31.28	195.1
Salix spp.	7.85	4.75	5.42	7.79	9.24	10.71	10.90	12.82	277.1
Pinus spp.	2.74	3.91	4.78	10.27	8.92	10.87	17.02	5.59	1297.5
Populus spp.	25.04	23.82	26.00	30.91	33.72	39.37	42.69	40.88	246.4
Robinia spp.	153.64	148.00	156.80	182.12	200.93	208.77	208.91	222.77	190.1
Other species	18.74	22.32	19.20	23.51	38.85	32.16	48.61	27.82	148.4
Total	401.84	396.83	429.89	485.45	541.47	587.20	624.33	607.32	228.6

Source: Statistical Records/Reports of "Moldsilva" Agency and of the State Ecological Inspectorate for the 1990-2015 time-series; Arcadie Capcelea, Aurel Lozan, Ion Lupu et al. (2011), *Analytical study on wood mass consumption in the RM.* "Moldsilva" Agency, Chisinau, 48 pages; Statistical Yearbooks of the ATULBD for 2000-2016.

The conversion to forest land during the reference period included afforestation under the Moldova Soil Conservation Project (MSCP) and Moldova Community Forestry Development Project (MCFDP). Both projects are implemented under the Clean Development Mechanism (CDM) of the Kyoto Protocol, and have completed all national and international validation and registration procedures.

Several goals are achieved within the respective projects: restoration of degraded land, improvement of local population supply with forest products and GHG absorption gain. The total area planted within these projects represent circa 28.8 thousand ha (Table 1-61). In addition to harvested forest products, the net decrease of CO_2 emissions into the atmosphere will account for circa 4.8 million tons (MSCP – 3.6 million t; MCFDP – 1.2 million t). The main participants in the implementation process of these projects are "Moldsilva" Agency, the World Bank, the Forestry Research and Development Institute (FRDI), territorial forestry entities, public authorities that have allocated land for afforestation (over 500).

Table 1-61: Annual Afforestation under the CDM Projects in the RM, ha

Afforestation Area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
MSC Project	5 197.3	4 971.9	4 477.6	4 152.1	985.6	60.5	329.9	99.0	16.0	0.0	20 289.9
MCFD Project	0.0	0.0	0.0	0.0	2 001.8	2 976.7	2 223.0	1 245.4	10.0	12.0	8 468.8
TOTAL CDM Projects	5 197.3	4 971.9	4 477.6	4 152.1	2 987.4	3 037.2	2 552.9	1 344.4	26.0	12.0	28 758.7

Source: PDD for MSCP and MCFDP; Annual Reports from "Moldsilva" Agency to the World Bank for 2004-2015 time series.

Activity data on forest land affected by fires are available in Statistical Yearbooks of the Republic of Moldova and those of the ATULBD (Table 1-62).

1.6.7. Waste Management

Current situation with the management of "Municipal Solid Waste" (MSW) in the Republic of Moldova is similar to the situation in other developing countries; it is in the budding stage and includes two basic elements: municipal solid waste generating sources and the landfills.

The generating process of municipal solid waste is influenced by multiple factors, the most relevant being the population income, consumer behavior, the use of new packed products, as well as the demographic evolution. The recent increase in the wellbeing of the population and the evolution of the urbanization process resulted in an increased waste generation rate per capita, varying, according to the World Bank's studies, between 0.3 and 0.4 kg/per capita/day in rural areas and around 0.9 kg/per capita/per day in urban areas. These data were taking into consideration during the development of the Republic of Moldova's Waste Management Strategy for 2013-2027[15].

Food consumption currently generates more and more waste. The introduction of new packages, plastic in particular, produces a significant negative impact on the environment. The polyethylene terephthalate (PET) packaging have replaced in the last years the glass packaging; while the polyethylene (PE) sacks, bags or boxes have replaced paper packaging, thus influencing the amount and composition of generated waste. The increasing number of markets, shops and supermarkets, along with an increase in welfare, respectively in purchasing power of packed products led to a greater capacity to generate waste, in particular in urban areas.

Waste generation indicators were revised in the Republic of Moldova during the completing process of the feasibility studies for the development of integrated waste management systems at regional level. According to the studies and analyses on the waste structure carried out by GIZ/GOPA in December 2015, FICHTNER in April 2016 and COWI/GOPA in July 2016, during the development of feasibility studies in waste management regions, the following values were proposed: for rural areas – 0.4 kg/per capita/day, for urban areas with a population up to 15 thousand inhabitants – 0.5 kg/per capita/day; for urban areas with a population between 15 and 40 thousand inhabitants – 0.7 kg/per capita/day, urban areas with more than 40 thousand inhabitants – 0.9 kg/per capita/day, while for Balti and Chisinau municipalities – respectively 0.9 kg/per capita/day and 1.3 kg/per capita/day. It should be mentioned that these calculations use AD on waste disposed provided by waste collection services.

Currently, the most used method of treating waste is waste disposal on sites, which often is a major source of soil pollution and groundwater contamination. In this context, sanitation and waste management services represent an important goal for local and governmental structures. According to the "State Ecological Inspectorate Yearbook for 2015 – Environment Protection in the Republic of Moldova", the total area of SWDS in urban areas represent circa 1,229.74 ha. In 2015 the area of authorized SWDS represented only 170.7 ha (NBS, 2016), therefore circa 1,059 ha were occupied by the so called "dump sites" (unauthorized landfills) situated especially in the rural areas of the Republic of Moldova. From the existing 1,158 landfills, about ¾ do not comply with sanitary and environment protection requirements and, the total amount of solid wastes accumulated on these sites cannot be estimated.

It should be noted that between 2010 and 2015 the construction of several landfills started in the country, in particular in district centers, serving the neighborhood villages. Thus, for example, new landfills became operational in 2013-2015 in Nisporeni, Telenesti and Hincesti. Within 2000-2015 time periods, through urban sanitation services, about 1,144 and 2,921 thousand m^3 of waste was transported to solid waste disposal sites. No statistical records on disposed waste volume is being made, there are only some visual estimates of environment inspectors, who appreciate the total volume of MSW disposed at approximately 35 million tons. To be noted that only 10 per cent of SWDS are enacted but even these are far from meeting environmental requirements since they are not operated properly: without compacting and using intermediary cover material to prevent the spread of fires and odors; lacking a strict control through weighing of disposed waste quality and quantity; there are no facilities to recover biogas produced or to recover/treat the filtrate; access road to and within the disposal sites are not maintained, vehicles are not washed on leaving the

[15] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=347341>.

Table 1-62: Forest Land Areas Affected by Fires in the RM, 1990-2015

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Right bank of Dniester river	120.10	20.10	22.00	1.50	33.50	1.40	0.00	0.00	9.70
Left bank of Dniester river	N/A	N/A	N/A	N/A	N/A	0.53	11.20	3.40	24.00
Total in the RM	120.10	20.10	22.00	1.50	33.50	1.93	11.20	3.40	33.70
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Right bank of Dniester river	0.00	0.00	41.60	12.50	10.50	42.00	5.50	32.60	683.30
Left bank of Dniester river	25.20	0.90	15.40	18.10	23.00	46.00	2.90	58.20	108.00
Total in the RM	25.20	0.90	57.00	30.60	33.50	88.00	8.40	90.80	791.30
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
Right bank of Dniester river	31.00	126.00	20.00	25.90	636.60	460.00	9.50	338.20	181.6
Left bank of Dniester river	24.00	8.20	26.90	36.90	35.80	7.10	28.90	18.00	N/A
Total in the RM	55.00	134.20	46.90	62.80	672.40	467.10	38.40	356.20	196.6

Source: Statistical Yearbooks of the RM for 1994 (page 38), 1999 (page 20), 2007 (page 22), 2011 (page 22), 2014 (page 22), 2015 (page 22); Statistical Yearbooks of the ATULBD for 2000 (page 88), 2002 (page 91), 2007 (page 81), 2009 (page 80), 2011 (page 82), 2014 (page 78), 2015 (page 88), 2016 (page 88) landfill; these sites do not have proper fences, an appropriate entry and warning signs. In most district towns the dump sites are overfilled, the disposed waste layer being 7-8 m deep (ex., in Ungheni, Cahul, Ocnita, etc.), at some landfills the layer is circa 10-15 m deep (ex., in Briceni, Balti, Ialoveni, etc.) and even 25-30 m deep (Tintareni and Orhei). Circa 3/4 of district town's landfills are being explored for circa 25-35 years at over 80 per cent of their capacity.

In recent years, there have been changes in waste management in Chisinau municipality. The landfill situated in Tintareni village, Anenii Noi district that served until recently Chisinau municipality became operational by the end of 1990 (de facto exploitation began in 1991); this landfill has an area of about 24.95 ha, of which net area represents 20.89 ha. According to the project, it was designed to storage until the end of 2010 about 44 million m^3 of solid waste. By 2011, when it's use stopped, only 19 million m^3 of solid waste were stored, which is less than half the capacity of the landfill. In fact, this landfill could still be used, but this is not possible due to repeated actions of blocking the access to the landfill by the residents of the nearby villages as a result of public opinion manipulation and the politicization of environment protection issues. Road blocking to the Tintareni landfill is considered by the specialists as a populist action, without any relevant supporting arguments for stopping its use. Meanwhile, since 2011 to 2017, Chisinau municipality has storied its waste near the waste transshipment station, located in Bubuieci village. The new location, was treated as a temporary solution, and became a serious environmental problem since waste was disposed on an unmanaged land, lacking environment protection measures such as sealing foundation, collecting storage gas, collecting and treating leachate, rainwater deviation etc. Since summer 2017, Chisinau municipality is storing again its waste at the Tintareni landfill.

Between 1986 and 2016, several waste morphologic composition studies have been performed in the Republic of Moldova. Figure 1-14 illustrates the shares of biodegradable fractions in the waste stream in the RM, indicating a decrease from circa 77.0 per cent in 1986, to circa 54.0 per cent in 2001 with a further increase to 72.4 per cent in 2005 and a subsequent decrease to circa 58.9 per cent in 2016.

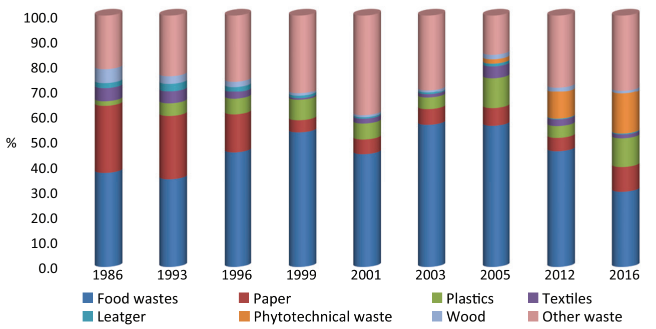


Figure 1-14: Biodegradable Waste in the Major Waste Streams in the Republic of Moldova.

The last study on the morphology of solid household waste generated in Chisinau, respectively Causeni and Straseni municipalities was conducted in 2016 by a technical team within the State Centre for Ecological Investigations, previously trained in similar waste management analysis, in fully cooperation with project experts from Climate Change Office and Prevention of Environment Pollution of the Ministry of Agriculture, Regional Development and Environment (Table 1-63).

Table 1-63: Average annual WDS Morphological Composition in 2016

Waste Type		Morphological Composition of Municipal Waste, %			
		Chisinau	Causeni	Straseni	Average
Recyclable Waste	Paper, cardboard	6.5	8.0	15.8	10.1
	Glass	5.5	6.0	5.7	5.7
	Plastics	7.0	14.2	12.8	11.3
	Metals and non-metals	1.5	1.8	1.5	1.6
Organic Waste	Food waste	26.4	33.6	29.2	29.7
	Phytotechnical Waste	19.5	11.8	16.3	15.9
	Textiles	2.9	0.3	1.3	1.5
	Shoes	0.1	0.8	0.3	0.4
Bulky Waste	Furniture	2.0	0.0	0.0	0.7
	Electronic and Electrical Equipment	0.3	0.5	0.0	0.3
Other Waste	Wood	1.7	0.2	0.0	0.6
	Construction and Demolition Waste	26.6	22.8	17.0	22.1

In 2013, with the support of GIZ Project „Modernization of local public services" and relying on the Waste Management Strategy of the Republic of Moldova for 2013-2027, approved by Government Decision no. 248 dated 10.04.2013, several activities of waste management planning were initiated at regional level. As a result, in February 2014 sectoral regional programs in waste management were approved for Central and North Development Regions, which enabled further development of feasibility studies.

As for the statistical sources on waste management records, it should be noted the Statistical Forms: F-1 "Toxic Waste" and F-2 "Waste" and Statistical Form "Special Road Transport", while since 2003, also the Statistical Form Nr.2–gc "Urban Settlements Sanitation" reflecting the amounts of municipal solid waste transported to landfills and approved by the Order of the Department of Statistics and Sociology, No. 83, from 01.08.2003.

The performed analyses revealed that only municipal solid waste is being transported to dumps by means of sanitation services, while other organic types of waste such as waste from food processing industry, from animal breeding and phytotechnical waste are disposed as well to the dumps, however, due to the fact that these types of waste are transported to the landfills through beneficiary transport units and are not included in the Statistical Form Nr.2–gc "Urban Settlements Sanitation". In these conditions, data on the amount of waste from food processing industry, from animal breeding and phytotechnical waste disposed were collected through the Statistical Form F-2 "Waste".

Table 1-64 refers only to the urban landfills were sanitation services exist and provide activity data to the National Bureau of Statistics of the Republic of Moldova. Historical AD regarding 1959-1984 time periods were deduced based on population number, the social-economic development conditions as well as waste generation trends. At the same time, the average value of the MCF was estimated considering the SWDS characteristics, such as managed or unmanaged SWDS and the deep of the disposed waste layer. By the end of 1990, the landfill in Tintareni village, Anenii Noi district became operational and serving Chisinau municipality (de facto use of this landfill started in 1991), while the GHG emissions generated by this landfill began in 1992.

Since 2001, the trends in waste generation per capita are steadily growing, in Chisinau city this level even exceeded the level recorded in the early 90's of the twentieth century. In 1990 year just 20 per cent of the waste was generated in Chisinau city, while in the last four or five years the share of Chisinau city represents about 30 per cent of the total amount of waste disposed in landfills. It should be mentioned also that statistical information sometimes does not reflect the real situation regarding the solid municipal waste management. Thus, for example, the amount of solid municipal waste disposed in rural areas are not subject to statistical evidence, as no sanitation services exist there. Also, although waste processing enterprises operate in the Republic of Moldova, information on the amount of recycled waste is not always subjected to a strict statistical evidence. Given the Republic of Moldova's intention to align to EU standards, the waste sector will be essentially restructured. In this context, the majority of SWDS are to be recover and their number – drastically reduced.

Table 1-64: Activity Data on the Amount of Solid Waste Disposed on Land and Industrial Waste Disposed on Land in the Republic of Moldova within 1959-2015

	Total	MSW			D_{ind}, kt	DDMS			Average MCF
	MSW + D_{ind}, kt	Total, kt	Inert waste, kt	Without inert waste, kt		Managed	Unmanaged, >5 m	Unmanaged, <5 m	
1959	595.26	357.16	103.56	253.60	238.11	0.0	10.0	90.0	23.4
1960	626.59	375.96	109.01	266.95	250.64	0.0	10.0	90.0	23.6
1961	659.57	395.74	114.75	280.99	263.83	0.0	15.0	85.0	23.8
1962	694.29	416.57	120.79	295.79	277.71	0.0	15.0	85.0	24.1
1963	730.83	438.50	127.17	311.33	292.33	0.0	15.0	85.0	24.3
1964	769.29	461.58	133.84	327.74	307.72	0.0	15.0	85.0	24.6
1965	809.78	485.87	140.88	344.99	323.91	0.0	15.0	85.0	24.8
1966	852.40	511.44	148.31	363.13	340.96	0.0	20.0	80.0	25.1
1967	897.26	538.36	156.11	382.25	358.91	0.0	20.0	80.0	25.4
1968	944.49	566.69	164.31	402.38	377.80	0.0	20.0	80.0	25.7
1969	994.20	596.52	172.90	423.62	397.68	0.0	20.0	80.0	26.1
1970	1046.53	627.92	182.09	445.82	418.61	0.0	20.0	80.0	26.4
1971	1162.81	697.68	202.30	495.38	465.12	0.0	25.0	75.0	27.2
1972	1224.01	734.40	212.98	521.43	489.60	0.0	25.0	75.0	27.6
1973	1288.43	773.06	224.19	548.87	515.37	0.0	25.0	75.0	28.0
1974	1356.24	813.74	235.97	577.77	542.50	0.0	25.0	75.0	28.4
1975	1427.62	856.57	248.44	608.13	571.05	0.0	25.0	75.0	28.9
1976	1502.76	901.66	261.46	640.19	601.10	0.0	30.0	70.0	29.4
1977	1581.85	949.11	275.24	673.87	632.74	0.0	30.0	70.0	29.9
1978	1665.11	999.06	289.73	709.34	666.04	0.0	30.0	70.0	30.4
1979	1752.74	1051.65	306.12	745.52	701.10	0.0	30.0	70.0	31.0
1980	1844.99	1014.75	294.26	720.48	830.25	0.0	35.0	65.0	31.2
1981	1892.30	1040.77	301.80	738.96	851.54	0.0	35.0	65.0	31.5
1982	1940.82	1067.45	309.55	757.91	873.37	0.0	35.0	65.0	31.9
1983	1990.59	1094.82	317.49	777.33	895.76	0.0	35.0	65.0	32.2
1984	2041.63	1122.89	325.64	797.25	918.73	0.0	35.0	65.0	32.5
1985	2093.98	1163.32	337.36	825.96	930.66	0.0	40.0	60.0	32.9
1986	2236.52	1242.51	360.33	882.18	994.01	0.0	40.0	60.0	33.8
1987	2217.94	1232.19	357.34	874.85	985.75	0.0	40.0	60.0	33.7
1988	2307.89	1282.16	371.83	910.33	1025.73	0.0	45.0	55.0	34.2
1989	2414.81	1341.56	389.04	952.53	1073.25	0.0	45.0	55.0	34.9
1990	2311.52	1359.72	394.31	965.41	951.80	0.0	45.0	55.0	34.6
1991	2204.61	1377.88	399.56	978.32	826.73	0.0	45.0	55.0	34.2
1992	2156.28	1437.52	416.88	1020.65	718.76	16.3	30.0	53.7	34.3
1993	1279.31	719.41	208.63	510.78	559.90	27.2	30.0	42.8	27.9
1994	1161.65	670.52	194.45	476.07	491.14	28.6	30.0	41.4	27.3
1995	1070.97	632.19	183.34	448.85	438.78	31.1	30.0	38.9	26.8
1996	1074.35	651.73	208.42	443.31	422.62	30.0	30.0	40.0	26.9
1997	1003.87	613.00	196.16	416.84	390.87	32.8	30.0	37.2	26.4
1998	1003.69	618.92	198.05	420.87	384.77	32.5	30.0	37.5	26.5
1999	947.81	580.75	220.67	360.08	367.06	32.9	30.0	37.1	26.1
2000	924.55	523.80	199.04	324.76	400.74	31.8	30.0	38.2	25.8
2001	867.26	475.49	213.98	261.52	391.77	31.9	30.0	38.1	25.4
2002	926.28	522.07	235.22	286.85	404.22	32.0	30.0	38.0	25.8
2003	975.80	548.08	186.35	361.73	427.72	30.6	30.0	39.4	26.1
2004	1041.40	575.44	195.64	379.80	465.96	29.4	30.0	40.6	26.5
2005	1109.58	602.50	162.68	439.83	507.08	28.3	30.0	41.7	26.9
2006	1205.78	653.59	176.47	477.12	552.18	27.2	35.0	37.8	27.5
2007	1529.12	847.37	228.77	618.60	681.74	30.8	35.0	34.2	29.6
2008	1760.41	1003.42	270.92	732.50	756.99	33.8	35.0	31.2	31.1
2009	1651.91	1114.28	300.86	813.42	537.63	35.8	35.0	29.2	31.2
2010	1531.58	1075.06	290.27	784.80	456.52	39.0	35.0	26.0	30.5
2011	1554.28	1091.58	294.73	796.84	462.70	40.1	35.0	24.9	30.7
2012	1590.83	1117.94	346.55	771.39	472.89	40.0	35.0	25.0	31.0
2013	1726.60	1214.21	376.40	837.81	512.39	37.8	35.0	27.2	31.9
2014	1824.88	1270.13	393.73	876.40	554.75	36.3	35.0	28.7	32.5
2015	1826.90	1270.69	393.92	876.78	556.21	39.1	35.0	25.9	32.5

CHAPTER 2: NATIONAL GREENHOUSE GASES INVENTORY

CHAPTER 2: NATIONAL GREENHOUSE GASES INVENTORY

2.1. Introduction

2.1.1. Convention, Kyoto Protocol and Party's Commitments

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted on May 9, 1992 at the UN Conference on Environment and Sustainable Development in Rio de Janeiro, being regarded as a response of the international community to the global warming phenomenon caused by air pollution and the increased concentrations of greenhouse gases.

The ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) is aimed *"to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"*. To-date 196 countries are Parties to the Convention. The Republic of Moldova signed the UNFCCC on June 12, 1992 and it was ratified by the Parliament on March 16, 1995.

Article 4, paragraph 1(a) and Article 12, paragraph 1(a) of the UNFCCC stipulate that each Party has to make available to the Conference of the Parties (COP) *"a national inventory of anthropogenic emissions by sources and removals by sinks, of all greenhouse gases uncontrolled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be agreed upon by the Conference of the Parties; also a general description of steps taken or envisaged by the Party to implement the Convention; and any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including, if feasible, relevant data for calculations of global emission trends"*.

The main mechanism for making this information available is national communications. COP 2 (Geneva, 1996) adopted the Guidelines on national communications for Non-Annex I Parties (Decision 10/CP 2). In conformity with the respective Guidelines, during 1998 to 2000, under the *UNDP-GEF Project "Enabling Activities for the preparation of the First National Communication under the UNFCCC"*, Republic of Moldova developed its FNC to UNFCCC, submitted to the COP 6 (Hague, 2000).

The COP 8 (New Delhi, 2002) adopted a new Guideline on national communications for Non-Annex I Parties (Decision 17/CP 8). In conformity with these Guidelines, during 2005-2009 period, under the *UNEP-GEF Project "Enabling Activities for the preparation of the Second National Communication under the UNFCCC"*, Republic of Moldova developed its SNC under the UNFCCC, within 2010-2013 period – the Third National Communication (TNC), while from 2014 to 2017, the Fourth National Communication (4thNC).

With reference to UNFCCC implementation instruments it should be noted that the COP 3 (Kyoto, 1997) adopted the Kyoto Protocol[16], representing an instrument setting binding targets for the Parties under Convention, by committing industrialized countries and economies in transition (in total, 37 industrialized countries and the European Union) included in Annex I to Convention, to reduce total emissions of direct GHG by at least 5 per cent, against 1990 levels over the five-year period: January 1, 2008 – December 31, 2012 (the first period of the Protocol commitment). The Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. As a Non-Annex I Party, the Republic of Moldova had no commitments to reduce GHG emissions under this Protocol.

According to the Bali Action Plan, adopted at the 13th Conference of Parties to the UNFCCC (2007), developing countries agreed for the first time to develop and implement *National Appropriate Mitigation Actions* in the context of sustainable development, supported by technology transfer, adequate financing and capacity-building actions.

The COP 15 held in Copenhagen in December 2009, approved and proposed for implementation a policy statement adopted in support of limiting global warming to no more than 2°C compared to pre-industrial level, in the context of equity and sustainable development. This statement, known as the Copenhagen Accord, reaffirms development issues in the context of climate change, inclusive through the implementation of Low Emission Development Strategies.

The Republic of Moldova associated itself to the Copenhagen Accord on January 2010 and submitted an emissions reduction target that is specified in Annex II of this Agreement *"National Appropriate Mitigation Actions in Developing Countries"*. The target of mitigation actions for Republic of Moldova under this Agreement is *"to reduce, to not less than 25 per cent compared to the base year (1990), the total national level of greenhouse gas emissions by 2020, by implementing economic mechanisms focused on global climate change mitigation, in accordance with the principles and provisions of the Convention"*. This target is presented without indicating specific national appropriate mitigation actions, identified and quantified, and without further clarification of the necessary support to achieve it. Simultaneously, it is recognized that achieving this target will require significant financial, technological and capacity-building support, which can be provided through the UNFCCC mechanisms.

In the same context, during 2010-2012, it was drawn the *Low Emissions Development Strategy of the Republic of Moldova until 2020*, a strategic document that was to allow the country to adjust its development path towards a low carbon economy and to achieve a green sustainable development, based on the socio-economic and development priorities of the country. Also, LEDS was supposed to support overall objectives, provide strategic national context for the mitigation efforts, for which countries would receive international support. LEDS was developed in accordance with the Republic of Moldova's Governance Programme "European Integration: Freedom, Democracy, Welfare" (2011-2014) and the provisions of chapter "Climate Change" of the European Union Association Agreement.

The Strategy contained a set of measures that would reduce greenhouse gas emissions, quantifying the corresponding reduction of GHG emissions for each measure, and the financial requirements for their implementation. The measures proposed in the prioritized list of NAMAs, an Annex to LEDS, included national appropriate mitigation actions, as provided for Non-Annex I Parties to the UNFCCC. LEDS also provided information on implementation procedures and timeframes, as well as provisions on monitoring, measurement, reporting and assessment of the results. The Strategy was drafted by the Ministry of Environment of the Republic of Moldova, the process being guided by the Inter-Ministerial Working Group

[16] The Kyoto Protocol entered into force on February 16, 2005, 90 days after its ratification by the Russian Federation in November 2004, thus covering at least 55 Parties to the Convention, including Annex I countries, which encompass 55 per cent of total carbon dioxide emissions recorded in 1990.

on Climate Change with support from the UNDP country office. This process involved wide consultations with all parties, represented by ministries, research institutions, donor organizations, NGOs and civil society. It was anticipated that LEDS would be approved by the Government by the end of 2013, which did not happen until the end of 2016[17].

The COP 16 held in Cancun in December 2010, adopted the Cancun Agreements, which encourages developing countries to prepare Low Emission Development Strategies for sustainable development and to undertake National Appropriate Mitigation Actions. The Cancun Agreements highlights the fact that "*stopping climate change requires a paradigm shift towards building a low-carbon emissions society, which offers substantial opportunities and ensures continued economic growth and sustainable development*".

At COP 16 it was also established the periodicity of national communications for the countries Non-Annex I (Decision 1/CP.16). In line with this, the Non-Annex I Parties should prepare and submit to the UNFCCC Secretariat *National Communications (NCs)* every four years and *Biennial Update Reports (BUR)* every two years. The inventory section of the BUR should consist of a *National Inventory Report (NIR)* as a summary or as an update of the information contained in Decision 17/CP.8, Annex, Chapter III (National Greenhouse Gas Inventories). The inventory section is expected to present in a detailed and transparent manner the procedures of national inventory for anthropogenic GHG emissions by sources or removals of carbon dioxide through sequestration, including information on emissions trends, key categories, activity data, emissions factors, assessment methodologies, quality assurance and quality control, uncertainties, recalculations and planned improvements, for each source or sink category included in the national inventory.

The COP 17 that took place in Durban in 2011 adopted the *UNFCCC biennial update reporting guidelines for Parties not included in Annex I to the Convention* (Decision 2/CP.17 and Annex 3 to this Decision). According to this decision, developing countries, Non-Annex I Parties, consistent with their capabilities and the level of support provided for reporting, were expected to submit their first BUR to the Secretariat of the UNFCCC by December, 2014. The Report should be submitted to the Secretariat at every two years as a stand-alone report or as a summary of the National Communications, where their reporting years coincides.

The Republic of Moldova initiated the process of preparing the First Biennial Update Report in July 2014, and managed to present it to the Secretariat of the UNFCCC on April 5, 2016. The First Biennial Update Report of the RM under the UNFCCC (2016) was presented to the Secretariat of the UNFCCC together with two technical annexes: National Inventory Report: 1990-2013, Greenhouse Gas Sources and Sinks in the Republic of Moldova (2015) and Report on the National GHG Inventory System in the Republic of Moldova (2015).

Regarding the Non-Annex I Parties, the COP 17 in Durban approved (Decision 2/CP.17 and Annex IV) the Modalities and Guidelines for International Consultation and Analysis (ICA) consisting of two steps: (i) the technical analysis of BURs and (ii) a facilitative sharing of views among Parties on BURs content and the results of technical analysis. The process aims to enhance the transparency and accountability of information reported in BURs by Non-Annex I Parties. The technical analysis is conducted by a team of technical experts (TTE) and is initiated within six months of BUR submission to the Secretariat.

As for the First Biennial Update Report of the RM under the UNFCCC, its technical analysis by the technical expert team took place between 19 and 23 of September 2016, with the summary report being published by the Secretariat on the UNFCCC web page on February 20, 2017[18]. The Facilitative Sharing of Views (FSV) among Parties on the BUR1 content and the results of technical analysis was carried out during the 3rd FSV workshop, organized by the UNFCCC Secretariat on 15th of May 2017 in Bonn, Germany[19].

The COP 18 (Doha, 2012) adopted the *Doha Amendment to the Kyoto Protocol* which establishes a second commitment period (January 1, 2013 – December 31, 2020) for the Parties included in Annex I to the Kyoto Protocol; adds a revised list of greenhouse gases to be reported; and a series of amendments to several articles of the Kyoto Protocol regarding the first commitment period. By December 21, 2012, the UN General Secretary, acting as depositary, presented the Doha Amendment to the Kyoto Protocol to all Parties of the UNFCCC, in accordance with provisions of Articles 20 and 21 of the Protocol. Under Doha Amendment, within the second commitment period, the developed countries should reduce their greenhouse gas emissions by at least 18 per cent compared to 1990 levels. By August 9, 2017[20], only 80 countries had ratified the Doha Amendment to the KP, most of which are Non-Annex I Parties to the UNFCCC and the KP.

At COP 19 (Warsaw, 2013), the Parties agreed to communicate their intended nationally determined contributions (INDC) (Decision 1/CP.19), in order to include them in the new Climate Agreement to be considered and adopted by the COP 21 in 2015, in Paris. The new climate agreement establishes a new commitment period (1st of January 2021 – 31st of December 2030) for reducing the GHG emissions. Also, COP 19 adopted *General guidelines for domestic measurement, reporting and verification of domestically supported nationally appropriate mitigation actions by developing country Parties* (Decision 21/CP.19). This document provides a solid foundation for the new Climate Agreement 2015.

At COP 20 (Lima, 2014) the Parties agreed over Lima Call for Climate Action and were repeatedly invited to communicate to the Secretariat their intended nationally determined contributions, in order to facilitate clarity, transparency and understanding. The INDC may include, as appropriate, inter alia: (i) quantifiable information on the reference point; (ii) time frames and/or periods for implementation; (iii) scope and coverage; (iv) planning processes; (v) assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals; and (vi) how the Party considers that its national circumstances, and how it contributes towards achieving the objective of the Convention as set out in its Article 2. According to *Lima Call for Climate Action*, countries were invited to communicate their intended nationally determined contributions by March 31, 2015, the deadline for

17 <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>.

18 <http://unfccc.int/files/national_reports/non-annex_i_parties/biennial_update_reports/submitted_burs/application/pdf/mda.pdf>.

19 The conclusions of the 3rd FSV workshop regarding the BUR1 of the RM under the UNFCCC and the results of the technical analysis are available on the web page: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/20170529_mda_v04.pdf>; RM's presentation at the 3rd FSV workshop is available on: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/moldova_fsv_workshop_presentation_15.05.2017.pdf>, while the video recording of the presentation and the interventions from the Parties are available on: <https://www.youtube.com/playlist?list=PL-m2oy1bnLzpmdRpG2pTBzUeOH3qrXlZt>.

20 < http://unfccc.int/kyoto_protocol/doha_amendment/items/7362.php>

the presentation being 1st of October 2015. The request to the Secretariat was to prepare by 1st of November 2015 a synthesis report on the aggregate effect of the INDC communicated by Parties.

The Republic of Moldova was fully committed to the UNFCCC negotiation process towards adopting at COP 21 a Protocol, another legal instrument or an agreed outcome with legal force under the Convention, applicable to all Parties, in line with keeping global warming below 2°C by 2100 compared to the preindustrial era.

The Paris Agreement was signed by the Prime Minister of the Republic of Moldova in New York on September 21, 2016, and was subsequently ratified by the Parliament through Law No. 78 from 04.05.2017 for the ratification of the Paris Agreement (Official Monitor No. 162-170 from 26.05.2017)[21].

At 25th of September 2015, the Republic of Moldova communicated its Intended Nationally Determined Contribution (INDC)[22] and the accompanying information to facilitate clarity, transparency, and understanding, with reference to decisions 1/CP.19 and 1/CP.20. According to its INDC, the Republic of Moldova intends to achieve an economy-wide unconditional target of reducing its greenhouse gas emissions by 64-67 per cent below its 1990 level in 2030 and to make best efforts to reduce its emissions by 67 per cent. The reduction commitment expressed above could be increased up to 78 per cent below 1990 level conditional to, a global agreement addressing important topics including low-cost financial resources, technology transfer, and technical cooperation, accessible to all at a scale commensurate to the challenge of global climate change. GHG emissions reduction targets have been set in an emission budget covering the period from January 1, 2021 to December 31, 2030. The GHG emission reduction targets set out in the Republic of Moldova's INDC were subsequently officially approved at national level by the Government Decision No. 1470 from 30.12.2016 regarding the approval of the Low Emissions Development Strategy of the Republic of Moldova by 2030 and the Action Plan for its implementation (Official Monitor No. 85-91 from 24.03.2017)[23].

[21] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=370323>
[22] <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Moldova/1/INDC_Republic_of_Moldova_25.09.2015.pdf>.
[23] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>

2.1.2. Greenhouse Gases

The most important greenhouse gas in atmosphere is water vapors (H_2O), responsible for approximately 2/3 of the total greenhouse effect. The content of water in atmosphere is not directly influenced by anthropogenic activities, but rather is determined by the cycle of water in nature, expressed in a simpler way, as the difference between evaporation and precipitations.

Carbon dioxide (CO_2) has a 30 per cent share in the greenhouse effect, while methane (CH_4), nitrous oxide (N_2O) and ozone (O_3) taken together account for 3 per cent. The group of artificial substances (man-made): chlorofluorocarbons (CFC) and their substitute, hydrofluorocarbons (HCFC, HFC) and other substances, as well as perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are also attributed to direct GHG. There are other photochemically active gases, such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) (include substances such as: propane, butane and ethane), which are not attributed to direct GHG, but have an indirect contribution to greenhouse effect. Such gases influence the formation and destruction of ozone in the atmosphere in the presence of solar rays (ultraviolet radiation) and are considered to be ozone precursors in the troposphere.

Though GHG are considered to be natural components of the air, their presence in atmosphere is strongly affected by anthropogenic activities. Increased concentrations of GHG in atmosphere (caused by emissions of anthropogenic origin) contribute to strengthening of greenhouse effect thus leading to additional warming of the atmosphere. The GHG concentration in atmosphere is determined by the difference between GHG emissions and removals. It has been stated with certainty that GHG concentration in atmosphere have increased significantly in comparison with pre-industrial level. Thus, from 1750 to the end of 2015, the concentration of CO_2 increased by circa 42.6 per cent, concentration of CH_4 – by 154.0 per cent, while N_2O concentration – by circa 21.5 per cent[24] (Table 2-1). To a great extent these trends can be attributed to human activities — in particular, to fossil fuels combustion and continuous deforestation of forest lands.

[24] <http://cdiac.ornl.gov/pns/current_ghg.html>

Table 2-1: Tropospheric Concentration (in the Northern Hemisphere), Concentration Change Rate and Direct GHG Lifetime in Atmosphere

Greenhouse Gases	Preindustrial tropospheric concentration (1850-1900)	Recent tropospheric concentration (end of 2015)	GWP (100-yr time horizon) (IPCC, 2013)	Tropospheric lifetime (years)	Increased radiative forcing[25] (W/m²)
Concentration in parts per million (ppm)					
Carbon dioxide (CO_2)	280	399.5	1	~ 100-300	1.94
Concentration in parts per billion (ppb)					
Methane (CH_4)	722	1834	28	12.4	0.50
Nitrous oxide (N_2O)	270	328	265	121	0.20
Tropospheric ozone (O_3)	237	337	n.a.	hours-days	0.40
Concentration in parts per trillion (ppt)					
CFC-11 (CCl_3F)	zero	232	4660	45	0.060
CFC-12 (CCl_2F_2)	zero	516	10200	100	0.166
CF-113 (CCl_2CClF_2)	zero	72	5820	85	0.022
HCFC-22 ($CHClF_2$)	zero	233	1760	11.9	0.049
HCFC-141b (CH_3CCl_2F)	zero	24	782	9.2	0.0039
HCFC-142b (CH_3CClF_2)	zero	22	1980	17.2	0.0041
Halon 1211 ($CBrClF_2$)	zero	3.6	1750	16	0.0010
Halon 1301 ($CBrClF_3$)	zero	3.3	6290	65	0.0010
HFC-134a (CH_2FCF_3)	zero	84	1300	13.4	0.0134
Carbon tetrachloride (CCl_4)	zero	82	1730	26	0.0140
Sulphur hexafluoride (SF_6)	zero	8.6	23500	3200	0.0049

[25] The "radiative forcing" term refers to the amount of any given GHG heat-trapping potential and it is measured in power units (watt) per surface units (m2).

By the end of 2015, globally, the amount of annual emissions of carbon dioxide represented circa 36.2 Gigatons (Gt)[26], which in the past 45 years has increased more than significantly (by circa 5 times). The most important sources of carbon dioxide emissions are fossil fuel combustion, deforestation and industrial processes (for example, cement production). The carbon dioxide lifetime in atmosphere varies between 100 and 300 years. It can be removed from atmosphere through a complex set of natural sinks mechanisms. Also, it is considered that circa 40 per cent of the emitted carbon dioxide can be absorbed by oceans. Photosynthesis, in particular in sea vegetation and plankton is an important, though transitory, mechanism of CO_2 emissions removal, because after the perishing of plants, carbon dioxide is again emitted into the atmosphere.

Concentration of methane in atmosphere is affected in proportion of circa 60 per cent by anthropogenic activities such as rice cultivation, animal breeding (enteric fermentation and manure management), coal, oil and natural gas extraction, transportation and distribution of natural gases, solid waste disposal on lands, biomass combustion, etc. The breakdown of methane in the atmosphere takes place through chemical reactions (by means of OH radicals). The lifetime of CH_4 in atmosphere is circa 12.4 years. The annual accumulation rate of CH_4 in atmosphere is about 40 and 60 Mt, from which approximately 11.5 per cent are generated from anthropogenic activities (in 2010, the global methane emissions represented circa 6.885 Mt and it is anticipated that, by 2020, will increase to 7.904 Mt[27]).

It has been stated that circa 40 per cent of the atmospheric N_2O is of anthropogenic origin[28], coming from use of synthetic nitrogen fertilizer, soil cultivation, animal breeding (manure management), wastewater handling, adipic acid and nitric acid production, fossil fuels combustion, waste incineration and biomass burning. The other 60 per cent of the atmospheric N_2O comes from the soil and denitrification of water in anaerobic conditions. N_2O breaks down photochemically in atmosphere.

[26] <http://edgar.jrc.ec.europa.eu/news_docs/jrc-2014-trends-in-global-co2-emissions-2014-report-93171.pdf>
[27] <https://www.globalmethane.org/documents/analysis_fs_en.pdf>
[28] <https://www.wmo.int/pages/mediacentre/press_releases/pr_1002_en.html>.

Global annual N_2O emissions from anthropogenic activities are estimated at circa 9Mt[29].

PFCs (perfluorocarbones), HFCs (hydrofluorocarbones) and SF_6 (sulphur hexafluoride) are GHG of anthropogenic origin. HFCs are preponderantly used to replace ozone depleting chemical substances, but it is also emitted in the process of HCFC-22 production. PFCs and SF_6 are emitted in various industrial processes, including aluminium and magnesia production, production of semiconductors, in transmission and distribution of electric power, etc. All these gases have a long lifetime in atmosphere and are characterized by a considerable infrared radiation absorption capacity, so that in the future it might have a considerable impact on the global warming.

2.1.3. Global Warming Potential

The radiative forcing effect of a gas in the atmosphere is the reflection of its ability to cause atmospheric warming. Direct effects occur when the gas itself is a GHG, while indirect radiative forcing occurs when chemical transformation of the original gas produces a gas or gases that are GHGs or when a gas influences the atmospheric lifetimes of other gases.

The concept of "Global Warming Potential" (GWP) has been developed to allow scientists and policy-makers to compare the ability of each GHG to trap heat in the atmosphere. By definition, a GWP is the time-integrated change in radiative forcing due to the instantaneous release of 1 kg of gas expressed relative to the radiative forcing from the release of 1 kg of CO_2. In other words, GWP is a relative measure of a warming effect that the emission of a radiative gas (i.e., GHG) might have on troposphere. The GWP of a GHG takes into account both the instantaneous radiative forcing due to an incremental concentration increase in the atmosphere and the lifetime of these gases in the atmosphere.

This report relates to the GWP for a period of 100 years recommended by the IPCC in IPCC Fourth Assessment Report (IPCC, 2007) for use in GHG emissions inventory under UNFCCC (Table 2-2).

[29] <http://edgar.jrc.ec.europa.eu/part_N2O.php#1overview>, <http://edgar.jrc.ec.europa.eu/ingos/JRC-INGOS-report.pdf>

Table 2-2: GWP for a Period of 100 Years and Direct GHG Atmospheric Lifetimes[30]

GHG	Chemical formula	Lifetime, according to AR5	SAR	TAR	AR4	AR5
Carbon dioxide	CO_2	50-200	1	1	1	1
Methane	CH_4	12.4	21	23	25	28
Nitrous oxide	N_2O	121	310	296	298	265
Nitrogen trifluoride	NF_3	500	NA	10800	17200	16100
Sulphur hexafluoride	SF_6	3200	23900	22200	22800	23500
Hydrofluorcarbons (HFC)						
HFC-23	CHF_3	222	11700	12000	14800	12140
HFC-32	CH_2F_3	5.2	650	550	675	677
HFC-125	C_2HF_5	28.2	2800	3400	3500	3170
HFC-134a	$C_2H_2F_2$ (CH_2FCF_3)	13.4	1300	1300	1430	1300
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	47.1	3800	4300	4470	4800
HFC-152a	C_2H4F_2 (CH_3CHF_2)	1.5	140	120	124	138
HFC-227ea	CF_3CHFCF_3	38.9	2900	3500	3220	3350
HFC-236fa	$CF_3CH_2CF_3$	242	6300	9400	9810	8060
HFC-245fa	$CHF_2CH_2CF_3$	7.7	NA	950	1030	858
HFC-365mfc	$CH_3CF_2CH_2CF_3$	8.7	NA	890	794	804
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	16.1	1300	1500	1640	1650
Perfluorocarbons (PFC)						
Perfluoromethane	CF_4	50000	6500	5700	7390	6630
Perfluoroethane	C_2F_6	10000	9200	11900	12200	11100
Perfluoropropane	C_3F_8	2600	7000	8600	8830	8900
Perfluorobuthane	C_4F_{10}	2600	7000	8600	8860	9200
Perfluoropenthane	C_5F_{12}	4100	7500	8900	9160	8550
Perfluorohexane	C_6F_{14}	3100	7400	9000	9300	7910

Source: SAR – Second Assessment Report (IPCC, 1996), TAR – Third Assessment Report (IPCC, 2001) and AR4 – Fourth Assessment Report (IPCC, 2007) and AR5 – Fifth Assessment Report (IPCC, 2013).

[30] < http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Annex-6-Additional-Information.pdf>

2.1.4. Republic of Moldova's Relative Contribution to Global Warming

The Republic of Moldova historic contribution to global warming is low. In 2015, the country contributed with circa 13.95 Mt CO_2 equivalent (without LULUCF) and 11.11 Mt CO_2 equivalent (with LULUCF), representing less than 0.04 per cent of total global GHG emissions.

Total and net emissions per capita, respectively, were less than half of the global average (3.5 t CO_2 equivalent per capita compared to 6.4 t CO_2 equivalent per capita, respectively 2.8 t CO_2 equivalent per capita compared to 6.8 t CO_2 equivalent per capita).

Also, the RM's share in global GHG emissions recorded since 1990 is low, under 0.05 per cent (without LULUCF) and less than 0.04 per cent (with LULUCF).

For example, within 1990-2015 period, the total national GHG emissions (without LULUCF) decreased by circa 67.8 per cent (Table 2-3), which is much more than in most industrialized countries and economies in transition included in Annex I to Convention (Figure 2-1).

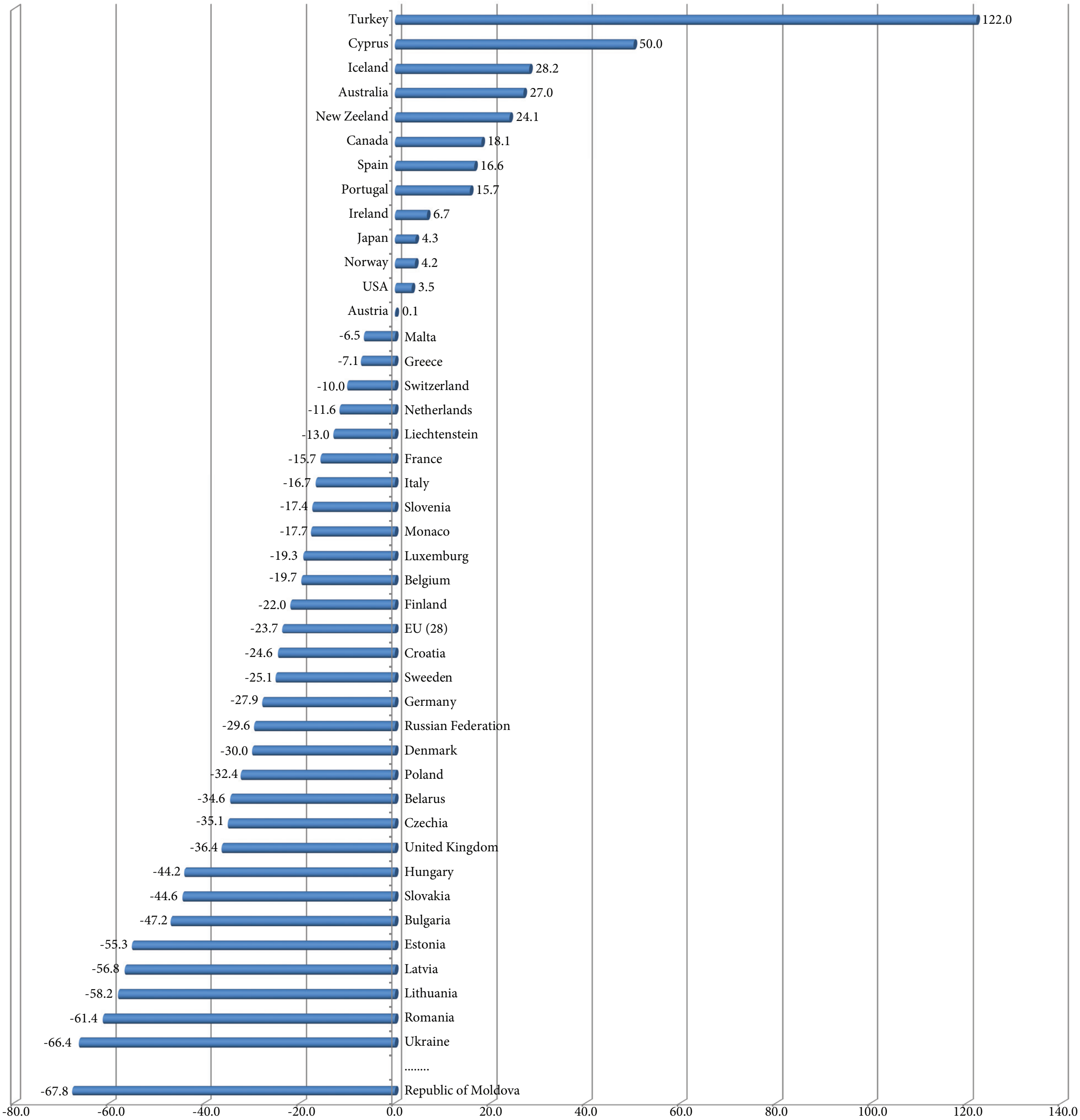


Figure 2-1: Total GHG Emissions from the Republic of Moldova (without LULUCF) and Annex I Parties to the Convention in 2015[31] (% compared to 1990)

[31] <http://unfccc.int/resource/docs/2017/sbi/eng/18.pdf>

Table 2-3: National Direct GHG Emissions in the Republic of Moldova within 1990-2015 periods

SOURCES OF GHG EMISSIONS	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
	CO_2 equivalent (kt)									
1. Energy	**34 630.7793**	**11 885.4927**	**6 787.8110**	**8 681.7347**	**9 828.7136**	**9 996.1204**	**9 654.5298**	**8 563.2692**	**9 344.7215**	**9 504.9423**
A. Fuel Combustion (sectoral approach)	33 817.9000	11 223.6852	6 186.8005	7 905.1774	9 247.6161	9 334.3990	9 002.3050	7 941.6657	8 747.7242	8 936.6798
1. Energy Industries	19 398.3484	6 904.3865	3 159.3286	3 233.2579	4 597.5705	4 187.9640	4 197.1458	3 316.4107	4 021.5062	4 147.0729
2. Manufacturing Industries and Construction	2 213.8153	465.0111	537.9965	604.8584	541.0995	601.4892	565.1582	601.6466	587.5527	668.2922
3. Transport	4 481.7645	1 522.9456	948.8464	1 767.9729	2 053.6866	2 164.2599	1 905.5612	2 015.0035	2 090.2898	2 202.9754
4. Other Sectors	7 608.4017	2 212.7842	1 514.3349	2 264.0705	2 031.0012	2 358.7490	2 326.6485	2 004.7593	2 046.0694	1 916.0651
5. Other	115.5701	118.5579	26.2941	35.0177	24.2583	21.9369	7.7913	3.8456	2.3060	2.2742
B. Fugitive Emissions from Fuels	812.8794	661.8075	601.0105	776.5573	581.0975	661.7214	652.2248	621.6035	596.9973	568.2625
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	812.8794	661.8075	601.0105	776.5573	581.0975	661.7214	652.2248	621.6035	596.9973	568.2625
C. CO_2 Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes and Product Use	**1 581.0137**	**453.5222**	**319.0457**	**598.5509**	**604.9577**	**698.5117**	**716.3927**	**770.2877**	**804.9205**	**795.0511**
A. Mineral Industry	1 316.1041	345.1199	240.0428	444.8424	412.7424	491.5026	496.8003	551.5523	548.2551	509.6941
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Industry	28.5023	26.2369	36.2689	41.9358	9.6985	12.8556	12.6973	7.6569	13.7976	17.2258
D. Non-energy Products From Fuels and Solvent Use	233.2089	76.4826	31.3591	68.4829	67.4640	72.7635	76.1943	71.3632	89.3660	86.8119
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NO	4.5879	10.4630	42.1522	113.4282	119.5378	128.8468	137.5611	151.3701	179.4375
G. Other Product Manufacture and Use	3.1983	1.0950	0.9118	1.1377	1.6246	1.8522	1.8540	2.1542	2.1317	1.8818
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Agriculture	**5 210.5504**	**3 590.5870**	**2 500.2063**	**2 576.5167**	**2 249.7258**	**2 204.0293**	**1 775.8023**	**2 249.0224**	**2 487.8723**	**2 114.6937**
A. Enteric Fermentation	2 190.6944	1 620.6669	1 085.6884	926.8686	712.6183	671.3756	634.3201	643.8453	681.6116	654.6016
B. Manure Management	1 611.4354	927.3910	549.3742	553.7250	498.5078	457.5476	421.4140	398.1773	435.7130	422.4326
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1 407.8386	1 042.4684	864.7040	1 095.7492	1 036.8553	1 071.4308	714.4773	1 202.8159	1 360.3419	1 031.8273
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
G. Liming	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Urea Application	0.5820	0.0607	0.4397	0.1739	1.7443	3.6752	5.5908	4.1840	10.2058	5.8323
I. Other Carbon-containing Fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. LULUCF	**-5 819.6508**	**-6 482.0548**	**-6 057.0210**	**-4 764.3654**	**-3 230.1116**	**-2 644.0178**	**-2 945.1468**	**-2 547.0470**	**-2 661.0447**	**-2 845.3994**
A. Forest Land	-2 543.3691	-2 025.7634	-2 288.3278	-2 390.3424	-2 489.4639	-2 373.1372	-2 205.9924	-2 053.6776	-2 019.1901	-2 026.1888
B. Cropland	-518.8554	-1 854.5890	-1 214.0578	-415.3529	-333.8237	-333.2723	-406.7558	-390.9015	-520.7267	-669.8527
C. Grassland	-2 850.2941	-3 088.4744	-2 844.3351	-2 240.7618	-555.7508	-442.6724	-426.1414	-277.4696	-271.1606	-306.2291
D. Wetlands	-17.4403	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
E. Settlements	87.8830	110.8718	102.9755	55.6592	47.2742	63.2853	12.2684	12.2684	19.0884	39.3890
F. Other Land	152.4756	392.7422	170.1387	281.6495	131.6759	466.0972	87.3375	87.3375	70.4783	60.8445
G. Harvested Wood Products	-130.0504	-16.8419	16.5854	-55.2171	-30.0233	-24.3184	-5.8631	75.3959	60.4660	56.6377
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	**1 977.7062**	**1 720.1979**	**1 600.6911**	**1 557.3015**	**1 580.1262**	**1 604.4245**	**1 601.8279**	**1 566.1229**	**1 561.9373**	**1 538.6611**
A. Solid Waste Disposal	1 046.7277	1 209.1845	1 169.5079	1 064.2940	1 137.8702	1 155.0902	1 143.6432	1 084.7888	1 083.0811	1 087.1519
B. Biological Treatment of Solid Waste	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
C. Incineration and Open Burning of Waste	28.3035	28.3243	28.0229	27.3593	26.9649	27.0530	27.0156	26.9722	26.8791	26.6656
D. Wastewater Treatment and Discharge	902.6749	482.6890	403.1602	465.6482	415.2911	422.2813	431.1691	454.3619	451.9772	424.8436
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items										
International Bunkers	**220.5278**	**42.4672**	**66.9765**	**68.4023**	**83.5573**	**96.4069**	**108.7812**	**131.8213**	**156.0630**	**220.6280**
Aviation	220.5278	42.4672	66.9765	68.4023	83.5573	96.4069	108.7812	131.8213	156.0630	220.6280
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	**229.3072**	**230.0502**	**272.3720**	**307.3920**	**343.3412**	**386.2234**	**404.3122**	**431.4636**	**1 317.1650**	**1 439.8048**
CO_2 Captured and Stored	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term Storage of C in waste disposal sites	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Indirect N_2O	**583.3295**	**357.6355**	**258.6705**	**305.8731**	**288.6536**	**288.6902**	**219.6508**	**307.2402**	**350.5447**	**278.9598**
Indirect CO_2	**207.3247**	**65.3743**	**26.4431**	**61.1468**	**60.4006**	**65.5327**	**70.0614**	**65.1517**	**83.0575**	**80.0300**
Total CO_2 equivalent (without LULUCF)	**43 400.0496**	**17 649.7999**	**11 207.7541**	**13 414.1038**	**14 263.5234**	**14 503.0859**	**13 748.5526**	**11 434.8817**	**14 199.4516**	**13 953.3482**
Total CO_2 equivalent (with LULUCF)	**37 580.3987**	**11 167.7451**	**5 150.7331**	**8 649.7384**	**11 033.4118**	**11 859.0681**	**10 803.4058**	**8 887.8348**	**11 538.4069**	**11 107.9488**

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring.

2.2. Institutional Arrangements, Process for Inventory Preparation

2.2.1. Institutional Arrangements for Inventory Preparation

The Ministry of Agriculture, Regional Development and Environment (MARDE) of the Republic of Moldova is the state authority responsible for development and promotion of policies and strategies addressing agriculture, food production and food safety, regional and rural development, use of territory, environment protection, climate change and natural resources. On behalf of the Government of Republic of Moldova, MARDE is in charge for implementation of international environment treaties to which the Republic of Moldova is a Part (including Rio Conventions). The representative of the MARDE is also the UNFCCC National Focal Point.

In view of implementing and accomplishing the UNFCCC provisions, as well as mechanisms and provisions of Kyoto Protocol, based on Order No. 21 as of February 11, 2004, the Climate Change Office (CCO) was established under the Ministry of Ecology, Constructions and Territory Development of the Republic of Moldova (reorganized initially into Ministry of Environment and Natural Resources, and later into Ministry of Agriculture, Regional Development and Environment).

The main tasks of the CCO are: providing logistical support to the Government, central and local public administration authorities, non-government and academic organizations, in activities implemented and promoted by the RM under the UNFCCC and Kyoto Protocol; and implementing climate change related projects and programs providing for such activities as: *GHG emissions evaluations and national inventory reports preparation*; development and implementation of GHG emissions mitigation activities; development and implementation of measures aimed to adapt to climate change; assessment of the climate change impact on environment and socio-economic components; cooperation, promotion and implementation of activities and projects under the Clean Development Mechanism (CDM) of the Kyoto Protocol; implementation and facilitation of activities aimed at building awareness and information among civil society, relevant experts and decision makers in climate change related issues etc.

In the above context, it is worth noting that the Climate Change Office was and remains fully responsible for activities related to the preparation of National Communications, and starting with 2014, of the Biennial Update Reports of the Republic of Moldova under the UNFCCC.

The role of CCO is also specified within the Government Decision No. 141 dated 24.02.2014 on creating the energy statistical system. Thus, Chapter 2.1, Paragraph 3(h) notes that the Climate Change Office is responsible for developing national inventories of direct (CO_2, CH_4, N_2O, HFC, PFC and SF_6) and indirect greenhouse gases (NO_x, CO, NMVOC and SO_2), originated from six sectors: Energy, Industrial Processes and Products Use, Agriculture, LULUCF and Waste.

The National Inventory System (NIS) includes all institutional and legal arrangements associated with the national greenhouse gas inventory preparation and reporting process on the national and international level, National Inventory Reports, Biennial Update Reports and National Communications. This process implies preliminary planning and preparation activities such as for example, defining specific responsibilities within the inventory preparation process - such responsibilities are described in section 2.2.2 'Institutional and Legal Arrangements', while Section 2.3 'Process for Inventory Preparation' provides more details about the inventory preparation process.

2.2.2. Institutional and Legal Arrangements

Within the MARDE, the Climate Change Office (CCO) is totally responsible for the activities related to preparation of National Communications (NCs), Biennial Update Reports (BURs), National Inventory Reports (NIRs) and National GHG Emission Inventory Reports. Figure 2-2 reveals the responsibilities and arrangements for the National Inventory System (NIS) of the RM.

Within the CCO the National Inventory Team (NIT) is responsible for estimating emissions by source categories and removals by categories of sinks, Key Categories Analysis (KCA), Quality Assurance (QA) and Quality Control (QC) procedures, uncertainties assessment, documentation, reporting and archiving of data related to GHG inventory, BURs and NCs preparation process.

Below is a brief description of functional responsibilities of the participants in the process:

- The Coordinator / Compiler of the National GHG Inventory is responsible for the inventory preparation process coordination, including supervision of estimating emissions by individual categories of sources and removals by individual categories of sinks, KCA, uncertainty analysis interpretation, QA&QC activities coordination, documentation and archiving the data used in the inventory preparation process, synthesis of sectoral reports - serving as basis for the NIR compilation, respectively Chapter 2 "GHG National Inventory" from the BURs and NCs;
- The national experts (hired on a contract basis) are responsible for estimating emissions by individual categories of sources and removals by individual categories of sinks at sectoral level (Sector 1 "Energy", Sector 2 "Industrial Processes and Product Use", Sector 3 "Agriculture", Sector 4 "LULUCF" and Sector 5 "Waste"); national experts are responsible for the activity data (AD) collection, application of decision trees in terms of selecting suitable assessment methods and EFs, estimating emission uncertainties by individual categories of sources, as well as for taking correction measures as a response to QA&QC activities.

The AD needed for developing the national GHG inventories are available in the Statistical Yearbooks (SY), Energy Balances (EBs) sectoral statistic publications, as well as in the on-line database of the National Bureau of Statistics (NBS) of the Republic of Moldova.

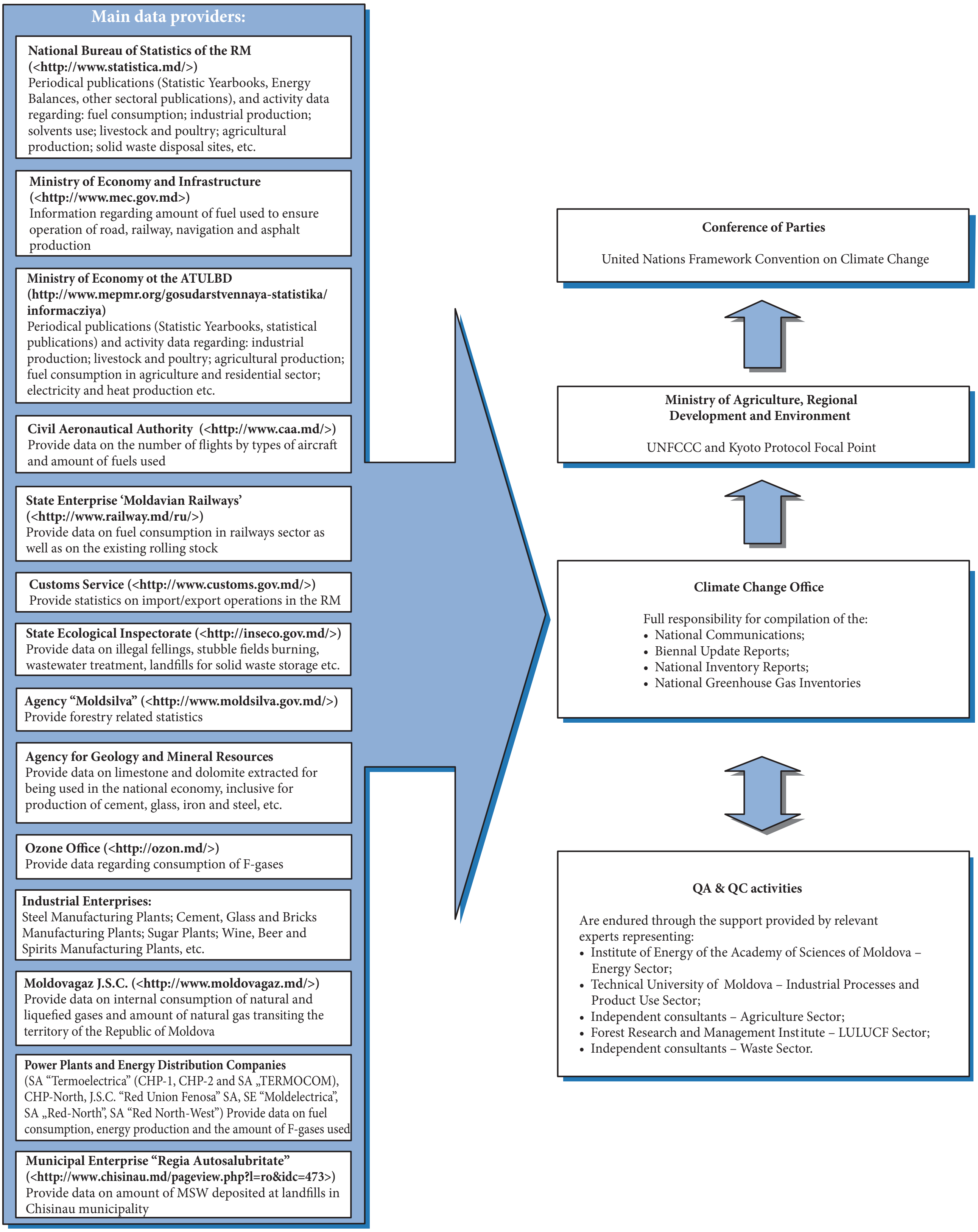


Figure 2-2: Institutional arrangements under the National Inventory System of the Republic Moldova

For the period until 1992, the information is available for the whole territory of the Republic of the Moldova, while since 1993 only for the right bank of Dniester (without Transnistria, further referred as Administrative Territorial Units on the Left Bank of Dniester). The statistical data for the left bank of Dniester are collected by the Statistical Yearbooks of the ATULBD and the State Statistical Service beside the Ministry of Economy of the ATULBD.

Additional statistical data (unpublished data) may be provided at request, in conformity with provisions of the *Law No. 412 as of 09.12.2004 on "Official Statistics", Article 9 (2), item a) and b)*, according to which "*the official statistics authorities must disseminate statistical data to users in the amount, manner and terms specified in the statistical works programme*", as well as to "*to ensure access of all users to non-confidential statistic on equal conditions in terms of amount and terms of dissemination*".

Based on the provisions of the *Law on Access to Information*, adopted by the Decision of the Parliament No. 982-XIV as of 11.05.2000, other relevant activity data is collected from various partner institutions:

- from Ministry of Economy and Infrastructure (has recently taken over the responsibilities of the former Ministry of Transport and Road Infrastructure, respectively, the Ministry of Information Technology and Communications): information on the amount of fuel used to ensure operation of road, railway, naval transport; on the amount of asphalt produced and used in the country; information on transport units registered, their type, ages of fleet and/or production year;
- from State Enterprise "Moldavian Railways": information of fuel used for rail transport, as well as on the rolling stock used by the enterprise;
- from Civil Aeronautical Authority: information on the amount of fuels used in air transportation (civil and international aviation) and the number of flights by type of aircrafts;
- from the Ministry of Defense: information on the amount of fuels used for military transportation;
- from the Ministry of Health, Labor and Social Protection: information on the use of medicines which contains aerosols (specifically on HFCs), as well as on use of N_2O for anesthesia purposes;
- from Agency "Moldsilva": information on forestry related statistics;
- from Land Relations and Cadaster Agency: information on land use by categories type;
- from Customs Service: statistics on import/export operations in the Republic of Moldova;
- from State Ecological Inspectorate: information on illegal felling and stubble fields burning;
- from Agency for Geology and Mineral Resources: information on limestone and dolomite extraction and use;
- from Ozone Office by the MARDE: information on import/export of freons in bulk and type of freons used in the imported refrigeration and air-conditioning equipment;
- from "IPROCOM" Institute: information on the characteristics of landfills for solid waste storage on the territory of the RM;
- from Municipal Enterprise "Regia Autosalubritate": information on landfill storage of solid household waste generated in Chisinau municipality;
- from "Moldovagaz" J.S.C.: information on the amount of natural gas transited through the territory of the Republic of Moldova, on the consumption of natural gas in the national economy, as well as on technical losses;
- from Power Plants ("TERMOELECTRICA" S.A. in Chisinau [CHP-1 S.A., CHP-2 S.A. and "TERMOCOM" S.A.], CHP-North S.A. in Balti: information on the amount of fuel used for electricity and heat production;
- from enterprises specialized in transportation and distribution of electricity (S.O.E. "Moldelectrica", I.C.S. "RED UNION FENOSA" J.S.C, "Red-North" J.S.C., "Red North-West" J.S.C.) – information on the amount of PFCs and SF_6 used in electrical equipment;
- from a range of industrial enterprises representing mainly the manufacture of non-metallic mineral products ("Lafarge Cement (Moldova)" J.S.C., "Macon" J.S.C., Glass Factory No. 1 in Chisinau, "Glass-Container" Company in Chisinau, etc.) – information on industrial output, amount of mineral resources used, amount of fuel used.

It should be mentioned that the Article 1 of the *Law on Access to Information* regulates the relationships between information providers and individual / legal entity in the process of ensuring and implementing the constitutional right of access to information; principles, conditions, ways and manner of accomplishing access to official data owned by information providers; aspects of access to and protection of personal information within the scope of access to such data; rights of data solicitants, including petitioners of personal data; obligations of information providers in the process of ensuring access to official information; ways to protect the right to access to information.

Article 4 (1) stipulates that "anyone, under this law's conditions, has the right to look for, receive and make public official information".

According to Article 6 (1), "official information are deemed to be all information owned and available to information providers, developed, selected, processed, consolidated and / or adopted by authorities or official persons or made available to them by other legal entities". This Article is a review of information bearing documents as stipulated by the provisions of this law. Article 7 refers to cases of limited access to official information. Rights of data solicitants are reflected in Article 10, while Article 11 refers to the obligations of information provider. According to Article 13 (1), ways of access to information are the following: hearing of information which can be provided verbally; document review on the premises of the institution; issuing a copy of the requested document or information; issuing a copy of the document, information translated into a different language than the language of the original, for an additional charge; sending by mail (including e-mail) of a copy of the document, information, a copy of the translated document, information into a different language, at the solicitant's request, for a charge. Article 13(2) stipulate that extracts from registers, documents, information, as per solicitant's request, can be made available to the solicitant in a reasonable and acceptable to the solicitant form.

Article 16 of the Law refers to the requirements that have to be met to ensure access to information: the requested information or documents shall be made available to the solicitant from the moment it becomes available for issuing, but not later than 15 working days from the date the application for access to information is registered; the leadership of the public institution may extend the term of providing the information, or document by 5 working days if: (1) the request refers to a very big volume of information requiring their selection; (2) additional consultations are needed to satisfy the request.

The solicitant will be informed about any extension of the information delivery term and about the reasons for such extension 5 days prior to the expiry of the initial term. The Law also refers to cases when access to information is denied, to payments for official information provision, to modalities of protecting the right for access to information and prosecution in court of information providers' actions. Also, a series of laws contain provisions pertaining to wide public to environment protection related information. So, Article 29 (3) of the *Law on Natural Resources*, adopted by the Parliament Decision No. 1102-XIII as of 06.02.1997, stipulates that *„Government, local public administration authorities, state bodies assigned with natural resources management and environment protection, as well as businesses, shall make public valid and accessible information regarding natural resources use and environment protection activities"*. Article 23 of the Forestry Code, adopted by the Parliament Decision No. 887 as of 21.06.1996, stipulates that "citizens and NGOs are entitled to receive information from the state forestry authorities and environment protection bodies about forestry and hunting resources, planned and accomplished conservation measures and use of such resources". The Regulation regarding trading and regulated use of halogenated hydrocarbons that deplete the ozone layer, approved by the Law No. 852-XV as of 14.02.2002, stipulates the procedure of presenting by the MoEN of information regarding production, import, export, trading and use (recycled and reclaimed quantities of controlled substances) of halogenated hydrocarbons that deplete the ozone layer, regulated by Montreal Protocol.

2.3. Process for Inventory Preparation

The Climate Change Office of the MARDE adopted a centralized approach to the process of preparing the national inventory comprising the NIR and standard estimation and reporting tables (Annex 1). The National Inventory preparation process is outlined in Figure 2-3.

The Coordinator of the National GHG Inventory is responsible for compiling the estimations and ensuring consistency and quality of the inventory by producing the NIR and Chapters 2 "National GHG Inventory" from the Biennial Update Reports and the National Communications. Estimation of emissions by individual source categories and removals by individual sink categories is the responsibility of national experts who have more competences about individual features of source/sink categories.

The national experts, under direct guidance of the Coordinator of the National GHG Inventory, decide, by applying decision trees, on employing the best estimation methodology, and collect AD needed for emissions estimation. For most source and sink categories methodologies used in the previous inventory cycle are applied. It is needed to collect new AD for a more recent period under review or for the entire period under review if historical AD were amended or recalculated. If a new source/sink category was to be assessed, or a higher Tier methodology had to be used, then the Coordinator of the National GHG Inventory with the national experts would decide on which assessment methodology to use, collect most reasonable AD and EFs, calculate GHG emissions, assess uncertainties, ensured implementation of verification, QA/QC procedures acting on behalf of research and academic institutions, ministries and subordinated institutions, central administrative authorities and/or private sector.

National experts produced explanatory texts for the research on estimation of emissions by individual source categories and removals by individual sink categories, as well as provided the bibliography used.

The Coordinator of the National GHG Inventory is responsible for collecting and reviewing these materials, used in drafting the NIR sectoral chapters (Chapter 3 "Energy", Chapter 4 "Industrial Processes and Product Use", Chapter 5 "Agriculture", Chapter 6 "LULUCF", Chapter 7 "Waste"). The Coordinator of the National GHG Inventory is also responsible for drafting other chapters (Executive Summary, Chapter 1 "Introduction", Chapter 2 "Trends in National GHG Emissions", Chapter 8 "Recalculations", "Bibliography" and "Annexes"), as well as for checking the correctness of the key category analysis, compatible with the 2006 IPCC Guidelines.

The NIR is produced in compliance with the general structure of the National Inventory Reports (NRI), as was established in the Decision 24/CP.19. In addition to NIR, the common reporting tables are filled-in.

The Coordinator of the National GHG Inventory has the task to monitor the process of producing the Sectoral and Summary Reporting Tables, to ensure the consistency of results. The national experts accomplished the uncertainties analysis, as well as verification and QA/QC activities, in close cooperation with the Coordinator of the National GHG Inventory.

The first *QA/QC Plan* was produced in 2006 within the UNDP-GEF Regional Project "*Capacity Building for Improving the Quality of the National GHG Inventories (Central Europe and CIS region)*", and complied with the 2006 IPCC Guidelines requirements. Subsequently, it was periodically updated during the national GHG inventory processes.

During the peer reviews, the draft version of the NIR is sent to a group of independent experts (who did not previously participate in the national inventory preparation). The purpose of the inventory peer reviews is to receive from relevant experts in the areas of major interest comments on quality of the work done, in particular on relevance of methodological approaches, EFs and AD used. The received comments are reviewed and estimations and explanatory notes to them are corrected. Following the final review, after the incorporation of comments received in the process of peer reviews, the Climate Change Office prepares the MS Word final version of the National Inventory Report, which is then sent for approval to the MARDE. When the Report is approved, the final version is electronically processed, printed and published.

Once published, the National Inventory Report, the Biennial Update Reports and/or the National Communications are submitted by the MARDE to the COP, in conformity with international commitments of the RM under the UNFCCC.

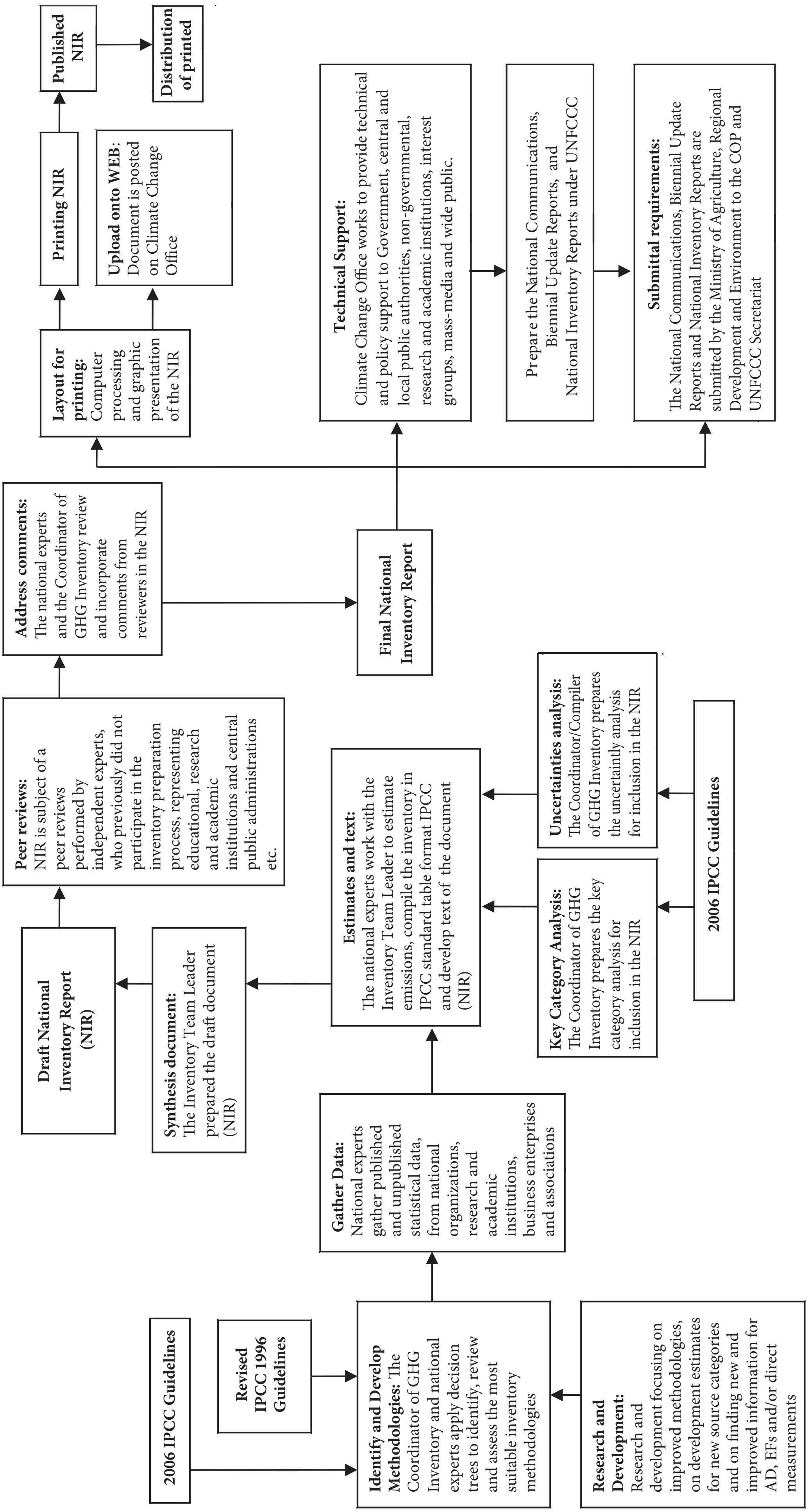


Figure 2-3: Inventory Process in the Republic of Moldova

2.4. Methodological Issues

2.4.1. Methodologies, Emissions Factors and Data Sources

The national inventory is structured to match the reporting requirement of the UNFCCC and is divided into five main sectors: (1) Energy, (2) Industrial Processes and Product Use, (3) Agriculture, (4) Land Use, Land-Use Change and Forestry and (5) Waste. Each of these sectors is further subdivided, within the inventory, by source categories (Table 2-4).

Emissions of direct (CO2, CH4, N2O, HFCs, PFCs and SF6) (no NF3 emissions have been registered in the Republic of Moldova so far) greenhouse gases were estimated based on methodologies contained in the 2006 IPCC Guidelines, while the indirect emissions (NOx, CO, NMVOC and SO2) were estimated based on methodologies according to the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), respectively according to the EEA/EMEP Air Pollutant Emission Inventory Guidebook (November 2016).

Generally, a GHG inventory can be defined as *a "comprehensive account of anthropogenic sources of emissions and removals by sinks and associated data from source and sink categories within the inventory area over a specified time frame"*.

It can be prepared "top-down", "bottom-up", or using a combination approach. The Republic of Moldova's national inventory is prepared using a "top-down" approach, providing estimates of GHG emissions at a national level. Ideally, a GHG inventory should be developed by using direct measurements of emissions and removals from individual categories of sources or sinks in the country, considering the methodological approach "bottom-up".

The national inventory team is continuously working to improve accuracy, completeness and transparency of its inventory. Comprehensive bottom-up inventory is neither practicable nor possible at the present time, although for some sectors, estimates are derived from individual source specific data.

To the extent possible, AD used in this report are based on officially published data: national (Statistical Yearbooks of the RM, respectively of the ATULBD (Transnistria), Energy Balances etc.) and international statistical publications (International Statistic Yearbook of Iron and Steel, UN FAO on-line database), publications of academic, research and development institutions (Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo" of the ASM, Institute of Ecology and Geography of the ASM, Institute of Power Engineering of the ASM, Forest Research and Management Institute, etc.), AD provided by ministries and subordinated institutions (Ministry of Economy and Infrastructure; MARDE; Ministry of Defense; Ministry of Health, Labor and Social Protection; Civil Aeronautical Authority of the Republic of Moldova; Customs Service; SEI, SHS, Agency for Geology and Mineral Resources, Ozone Office) and central administrative authorities (National Bureau of Statistics, Agency for Land Relations and Cadaster, Agency "Moldsilva"), data obtained from enterprises and businesses associations (State Enterprise "Moldavian Railways", "Moldovagaz" J.S.C., "Lafarge Cement (Moldova)" J.S.C., "Macon" J.S.C., "Glass Plant No.1" J.S.C., "Glass Container Company" J.S.C., M.E. "Cristal-Flor" J.S.C., etc.), legislation acts (*National Complex Program of Enhancing Soil Fertility in 2001-2020*, approved by the Government Decree No. 591 as of 20.06.2000; *Complex Program for Reclamation of Degraded Lands and Enhancing Soils Fertility. Part I Reclamation of degraded lands*, approved by the Government Decree No. 636 as of 26.05.2003 and *Complex Program for Reclamation of Degraded Lands and Enhancing Soils Fertility, Part II Enhancing Soils Fertility*, approved by the Government Decree No. 841 as of 26.07.2004 etc.).

2.4.2. Key Categories

According to 2006 IPCC Guidance, it is *good practice* to identify key categories, as it helps prioritize efforts and improve the overall quality of the national inventory. A "key category" is defined as a "source or sink category, that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both".

Table 2-4: Summary of Methods and Emission Factors Used for Inventory Preparation Process in the Republic of Moldova

Categories by sources and sinks	CO_2		CH_4		N_2O		HFC		PFC		SF_6	
	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
1. Energy												
A. Fuel Combustion	T1	D, CS	T1	D	T1	D						
1. Energy Industries	T1	D, CS	T1	D	T1	D						
2. Manufacturing Industries and Construction	T1	D, CS	T1	D	T1	D						
3. Transport	T1	D, CS	T1	D	T1	D						
4. Other Sectors	T1	D, CS	T1	D	T1	D						
5. Other	T1	D, CS	T1	D	T1	D						
B. Fugitive Emissions from Fuels	T1	D, CS	T1	D	T1	D						
1. Solid Fuels	NO	NO	NO	NO	NO	NO						
2. Oil and Natural Gas	T1	D, CS	T1	D	T1	D						
C. CO_2 Transport and Storage	NO	NO										
2. Industrial Processes and Product Use												
A. Mineral Industry	T2, T1	D, CS	NA	NA	NA	NA						
B. Chemical Industry	NO	NO	NO	NO	NO	NO						
C. Metal Industry	T2	CS, D	NO	NO	NO	NO						
D. Non-energy Products From Fuels and Solvent Use	T2, T1	D	NA	NA	NO	NO						
E. Electronic Industry	NA	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NA	NA	NA	NA	NA	NA	T2, T1	CS, D	NA	NA	NA	NA

Categories by sources and sinks	CO_2		CH_4		N_2O		HFC		PFC		SF_6	
	Meth-od	EF	Meth-od	EF	Meth-od	EF	Meth-od	EF	Meth-od	EF	Meth-od	EF
G. Other Product Manufacture and Use	T2, T1	D	NA	NA	T1	D	NA	NA	T1	D	T1	D
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Agriculture												
A. Enteric Fermentation			T2, T1	D, CS	NA	NA						
B. Manure Management			T2, T1	D, CS	T2, T1	D, CS						
C. Rice Cultivation			NO	NO	NA	NA						
D. Agricultural Soils			NA	NA	T1, T3	D, CS						
E. Prescribed Burning of Savannas			NO	NO	NA	NA						
F. Field Burning of Agricultural Residues			IE	IE	IE	IE						
G. Liming	NO	NO	NA	NA	NA	NA						
H. Urea Application	T1	D	NA	NA	NA	NA						
I. Other Carbon-containing Fertilizers	NO	NO	NA	NA	NA	NA						
J. Other	NO	NO	NO	NO	NO	NO						
4. LULUCF												
A. Forest Land	T3, T2, T1	D, CS	T1	D	T1	D						
B. Cropland	T2, T1	D, CS	T1	D	T1	D						
C. Grassland	T2	CS	NE	NE	NE	NE						
D. Wetlands	T2, T1	D, CS	NE	NE	NE	NE						
E. Settlements	T2, T1	D, CS	NE	NE	T1	D						
F. Other Land	T2, T1	D, CS	NE	NE	NE	NE						
G. Harvested Wood Products	T1	D	NA	NA	NA	NA						
H. Other	NO	NO	NO	NO	NO	NO						
5. Waste												
A. Solid Waste Disposal	NA	NA	T3	D, CS	NA	NA						
B. Biological Treatment of Solid Waste	NA	NA	NO	NO	NO	NO						
C. Incineration and Open Burning of Waste	T1	D	T1	D	T1	D						
D. Wastewater Treatment and Discharge	NA	NA	T1	D, CS	T1	D						
E. Other	NO	NO	NO	NO	NO	NO						
6. Other	NO	NO	NO	NO	NO	NO						
Memo Items												
International Bunkers	T2, T1	D, CS	T1	D	T1	D						
Multilateral Operations	NO	NO	NO	NO	NO	NO						
CO_2 Emissions from Biomass	T1	D, CS	IE	IE	IE	IE						
CO_2 Captured and Stored	NO	NO	NA	NA	NA	NA						

Abbreviations: T1 – Tier 1 Method; T2 – Tier 2 Method; C – EMEP/EEA; CS – Country Specific; D – Default; IE – Included Elsewhere; NA – Not Applicable; NE – Not Estimates; NO – Not Occurring.

Table 2-5, respectively Annex 1, presents the key categories for the Republic of Moldova's National GHG Inventory, 1990-2015, without LULUCF – based on the Tier 1 methodological approach, 16 key categories by level (L) and 16 key categories by trend (T); based on a Tier 2 approach – 14 key categories by level (L) and 12 key categories by trend (T); with LULUCF – based on the Tier 1 methodological approach – 20 key categories by level (L) and 16 key categories by trend (T); based on a Tier 2 approach – 19 key categories by level (L) and 14 key categories by trend (T).

Following the recommendations set in the 2006 IPCC Guidelines, the inventory was first disaggregated by source categories which further were used to identify key categories.

Source and sink categories were defined in conformity with the following guidelines:

(1) emissions/ removals from individual source/sink categories identified according to standard classification, were expressed CO_2 equivalent units, estimated by using the GWP;

(2) a category should be identified for each gas emitted by the sources and sinks, since the methods, emission factors, and related uncertainties differ for each gas;

(3) source and sink categories that use the same emission factors based on common assumptions were aggregated before analysis.

Key categories were identified from two perspectives:

(1) the first analysis the emission contribution that each category makes to the national total; and

(2) the second perspective analysis the trend of emission contributions from each category to identify where the greatest absolute changes (either increases or reductions) have taken place over a given time.

The per cent contributions to both levels (L), and trends (T), in emissions are calculated and sorted from greatest to least (see details in Annex 1). When a Tier 1 approach was used, a 95 per cumulative contribution threshold has been used in this analysis to define an upper boundary for the key category identification, respectively when a Tier 2 approach was used (considering AD and EFs uncertainties used to estimate GHG emissions for individual source/sink categories), a 90 per cumulative contribution threshold has been used in this analysis to define an upper boundary for the key category identification.

The Key Category Analysis was carried out using the Key Category Calculation Tool developed by the United States Environment Protection Agency (US EPA v2.5).

Table 2-5: Summary Overview of the Republic of Moldova's Key Categories for 1990-2015, Based on a Tier 1 and Tier 2 Approaches

IPCC classification	Key Categories	Gas	Without LULUCF				With LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
1A1	Energy Industries	CO_2	X	X	X	X	X	X	X	X
1A2	Manufacturing Industries and Construction	CO_2	X	X	X		X		X	
1A3b	Road Transportation	CO_2	X	X	X	X	X	X	X	X
1A3c	Railways	CO_2	X	X			X			
1A4	Other Sectors	CO_2	X	X	X	X	X	X	X	
1A4	Other Sectors	CH_4	X		X		X		X	
1B2	Fugitive Emissions from Oil and Natural Gas	CH_4	X	X	X	X	X	X	X	X
2A1	Cement Production	CO_2	X	X			X	X		
2A2	Lime Production	CO_2		X						
2F1	Product Uses as Substitutes for ODS – Refrigeration and Air Conditioning	HFC		X		X				
2F2	Product Uses as Substitutes for ODS – Foam Blowing	HFC	X	X		X		X		X
3A	Enteric Fermentation	CH_4	X	X	X		X		X	
3B	Manure Management	CH_4	X	X	X	X	X		X	
3B1-4	Direct N_2O Emissions from Manure Management	N_2O	X		X		X		X	
3B5	Indirect N_2O Emissions from Manure Management	N_2O			X	X			X	
3Da	Direct N_2O Emissions from Managed Soils	N_2O	X	X	X	X	X	X	X	X
3Db	Indirect N_2O Emissions from Managed Soils	N_2O	X	X	X	X	X	X	X	X
4A1	Forest Land Remaining Forest Land	CO_2					X	X	X	X
4A2	Land Converted to Forest Land	CO_2					X	X	X	X
4B1	Cropland Remaining Cropland	CO_2					X	X	X	X
4B2	Land Converted to Cropland	CO_2					X	X	X	X
4C2	Land Converted to Grassland	CO_2					X	X	X	X
4G	Harvested Wood Products	CO_2						X		X
5A	Solid Waste Disposal	CH_4	X	X	X	X	X	X	X	X
5D	Wastewater Treatment and Discharge	CH_4	X	X	X	X	X	X	X	X

Abbreviations: L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2.

2.4.3. Quality Assurance and Quality Control

Following the recommendations from the 2006 IPCC Guidelines, national inventories have to be transparent, well documented, consistent, complete, comparable, assessed for uncertainties, subject to verification and QA/QC.

The 2006 IPCC Guidelines defines the QA/QC terms as follows:

- Quality Control (QC) is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. A basic QC system should provide routine and consistent checks to ensure data integrity, correctness, and completeness; identify and address errors and omissions; and document and archive inventory material and record all QC activities.
- Quality Assurance (QA) comprises a planned system of review procedures conducted by personnel not directly involved in the inventory compilation and development process.

As a part of continuous efforts to develop a transparent and reliable inventory, the Republic of Moldova developed a "Quality Assurance and Quality Control Plan". The key attributes of the "Quality Assurance and Quality Control Plan" include detailed specific procedures (see Figure 2-4) and standard verification and quality control forms and checklists (Annex 4 of the NIR), by using Tier 1 (general procedures) and Tier 2 (source-specific procedures), that serve to standardize the process of implementing quality assurance and quality control activities meant to ensure the quality of the national inventory; peer review carried out by experts not directly involved in the national inventory development process; data quality check including by comparing the sets of data obtained from different sources; inventory planning and coordination at an inter-institutional level; as well as the continuous documentation and archiving of all materials used in inventory preparation process.

It is well known that inventory development implies huge amounts of information that has to be gathered, handled and stored. The process sustainability is ensured through a good management and archiving of materials used along the inventory process.

In the Republic of Moldova, the National Inventory Team has a sufficiently transparent documentation allowing to fully reproducing the GHG emissions estimates. A standard system for documenting and archiving numeric and qualitative information, in compliance with the 2006 IPCC Guidelines recommendations was used. The activity data sources were documented by inserting references to these into the inventory document text. Estimation methods & emission factors sources and their selection justification are documented in the corresponding chapters of the NIR.

Recalculations made are documented and argued both in sectoral Chapters (3-7), as well as in the Chapter 8 "Recalculations and Improvements" of the NIR.

Individual source and sink categories related documentation include: (1) list of personnel responsible for estimates and individual responsibilities as per Terms of Reference; (2) reference sources for the activity data used; (3); justification of emission factors estimation methods selection; (4) samples of GHG emissions estimation process (in Excel format); (5) uncertainties analysis results by individual source and sink categories; (6) annexes; (7) references.

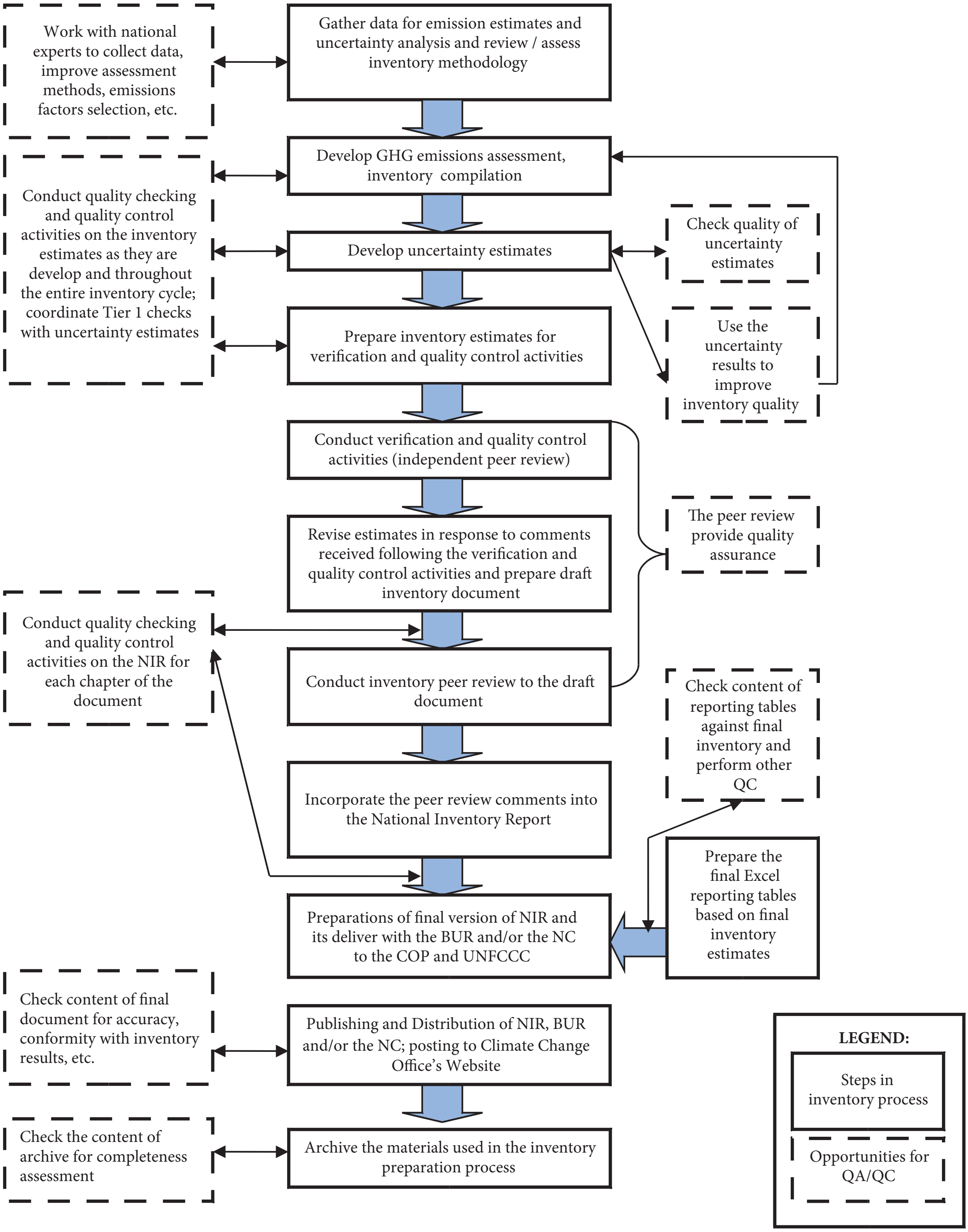


Figure 2-4: The Role of QA/QC Activities in the Inventory Preparing Process.

Materials used in the inventory development process were archived both electronically and on hard copies. As the entity responsible for the national inventory development, the Climate Change Office holds all documentation used for its compilation.

Summing up, one can assert that transparency and credibility of a national inventory are ensured through: (1) the ability to demonstrate, through appropriate documentation, transparency of inventory development process; (2) further improvements of the inventory process and its basic products; and (3) ensuring that the inventory process employed consistent approaches allowing to obtain comparable results for all source and sink categories.

It is obvious that in comparison with the previous inventory cycles, by continuous integration of QA/QC activities, the Republic of Moldova ensures a better quality inventory.

2.4.4. Recalculations

The national inventory team revised and recalculated GHG emissions and CO_2 removals for each calendar year covered by the inventory for the period from 1990 through 2013, a component part of the BUR1 of the Republic of Moldova under the UNFCCC (2016). These activities were carried out during the on-going process of improving the quality of the National GHG Inventory (including, by taking into account the updated activity data, new methodological approaches available in the 2006 IPCC Guidelines [the complete transition to this Guidelines has been achieved in the current inventory cycle], emission factors used, and identified errors correcting actions).

Under the current inventory cycle, improvements were made in all sectors (move to higher tier methodologies, revision of previously used methodological approaches and emission factors, activity data etc.), entailing the need to make recalculations of national GHG emissions for the time period from 1990 through 2013, reflected in the First Biennial Update Report of the Republic of Moldova under the UNFCCC (Chapter 2 „National GHG Inventory").

In comparison with the results reported under the BUR1, the changes made during the development of the current inventory, resulted in insignificant increased values of total direct GHG emissions in 1991 and 1994-2012, respectively revealed a decreasing trend in 1990, 1992-1993 and 2013 (Table 2-6).

Table 2-6: Recalculations of Total Direct GHG Emissions included into the BUR1 of the Republic of Moldova under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	43.4188	38.7474	28.7545	23.2180	20.9914	17.4240	17.2640	16.0256
NC4	43.4000	38.9878	28.3850	22.9386	21.2027	17.6498	17.7123	16.3028
Difference, %	-0.04	0.6	-1.3	-1.2	1.0	1.3	2.6	1.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	14.0442	11.7718	10.7307	11.4210	11.1419	11.6173	12.3044	12.7530
NC4	14.4061	12.1228	11.2078	11.9762	11.8020	12.2221	12.9717	13.4141
Difference, %	2.6	3.0	4.4	4.9	5.9	5.2	5.4	5.2
	2006	2007	2008	2009	2010	2011	2012	2013
BUR1	11.9433	11.6586	13.0587	13.1368	13.9394	14.1417	13.3642	12.8363
NC4	12.5625	12.2087	13.4685	13.4743	14.2635	14.5031	13.7486	11.4349
Difference, %	5.2	4.7	3.1	2.6	2.3	2.6	2.9	-10.9

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

With reference to the net direct GHG emissions included into the BUR1 of the RM under the UNFCCC, changes made in the development of the current inventory, resulted in decreased emissions between 1991 and 2013, varying from a minimum of 0.8 per cent in 2012 to a maximum of 44.8 per cent in 2008; with the exception of 1990, when an insignificant increase of net direct GHG emissions was recorded (by 0.1 per cent) (Table 2-7).

Table 2-7: Recalculations of the Total Net Direct GHG Emissions included into the BUR of the Republic of Moldova under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
BUR1	37.5322	33.4510	24.3701	21.7173	18.8274	16.3946	16.0973	15.8886
NC4	37.5804	31.4104	21.3336	15.8020	14.8571	11.1677	11.4861	10.2141
Difference, %	0.1	-6.1	-12.5	-27.2	-21.1	-31.9	-28.6	-35.7
	1998	1999	2000	2001	2002	2003	2004	2005
BUR1	13.3216	10.6370	9.3385	10.6710	10.6092	10.0626	12.2012	12.3776
NC4	8.2647	6.0108	5.1507	6.1833	6.9351	7.2948	9.0870	8.6497
Difference, %	-38.0	-43.5	-44.8	-42.1	-34.6	-27.5	-25.5	-30.1
	2006	2007	2008	2009	2010	2011	2012	2013
BUR1	11.3042	8.5926	12.9992	11.8519	13.2823	13.7120	10.8939	12.7387
NC4	7.5270	7.1845	8.9809	9.6222	11.0334	11.8591	10.8034	8.8878
Difference, %	-33.4	-16.4	-30.9	-18.8	-16.9	-13.5	-0.8	-30.2

Abbreviations: NC4 – Fourth National Communication; BUR1 – First Biennial Update Report.

2.4.5. Uncertainty Assessment

Uncertainty estimates are an essential element of a complete and transparent emissions inventory. Uncertainty information is not intended to challenge the validity of inventory estimates, but to help prioritize efforts to improve the accuracy of future inventories and guide future decisions on methodological choice.

While the Republic of Moldova's National Inventory Team calculates the emission estimates with the highest possible accuracy, uncertainties are associated to a varying degree with the development of emission estimates for any inventory.

Some of current estimates, such as those for CO_2 emissions from fossil fuels combustion or from cement production are considered to have minimal uncertainty associated with them. For some other categories of emissions, however, a lack of data, the use of emission factors used by default or an incomplete understanding of how emissions are generated increases the uncertainty surrounding the estimates presented.

Additional research in the following areas could help reduce uncertainty in the Republic of Moldova's Inventory:

Incorporating excluded emission sources. Quantitative estimates for some of the sources and sinks of GHG emissions are not available at this time (for example, GHG emissions from source category 5B "Biological Treatment of Solid Waste").

Improving the accuracy of emission factors. Further research is needed in some cases to improve the accuracy of emission factors used to calculate emissions from a variety of sources (for example, the accuracy of current emission factors applied to CH_4 fugitive emissions from oil and natural gas, emissions of CO_2 from solvents and other products, indirect N_2O emissions from waste management and indirect N_2O emissions from agricultural soils etc., is highly uncertain etc.).

Collecting more detailed activity data. Although methodologies for estimating emissions for some sources exist, problems arise in obtaining activity data at a level of detail in which aggregate emission factor can be applied, in particular the ability to estimate emissions of F-gases (HFC, PFC, SF_6 and NF_3) within Sector 2 "Industrial Processes and Product Use".

The overall inventory uncertainty was estimated using a Tier 1 methodological approach. An estimate of the overall quantitative uncertainty (±8.45 per cent level uncertainty and, respectively ±2.37 per cent trend uncertainty) are shown in Table 2-8, as well as in the Annex 5 of the NIR.

Table 2-8: Estimated Overall National Inventory Quantitative Uncertainty

	CO_2	CH_4	N_2O	Total
Level Uncertainty	±8.06	±21.86	±29.31	±8.45
Trend Uncertainty	±1.97	±10.44	±10.74	±2.37

Emissions evaluated under the RM's National GHG Inventory reflect current best estimates; in some cases, however, estimates are based on approximate methodologies, assumptions, and incomplete data. As new information become available in the future, the RM's inventory team will continue to improve, revise and recalculate its GHG emission estimates.

2.4.5. Completeness Assessment

Republic of Moldova's National GHG Inventory is, mostly, a complete inventory of the following direct GHG – CO_2, CH_4, N_2O, HFC, PFC and SF_6.

The national inventory includes also the indirect GHGs such as: CO, NOx, NMVOC and SO_2.

Despite the effort to cover all existent sources and sinks, the inventory still has some gaps, most being determined by lack of activity data needed to estimate certain emissions and removals, such as:

- emissions of HFCs from source categories 2F3 "Fire Protection", 2F5 "Solvents" and 2F6 "Other Applications";
- CH_4 emissions from source category 5B "Biological Treatment of Solid Waste".

As part of the inventory improvement plan, during the future inventory activities, the inventory team will continue the efforts to identify new and relevant data for the GHG emissions/removals assessment.

2.5. Reporting Greenhouse Gas Emissions

2.5.1. Summary of Direct GHG Emission Trends

Between 1990 and 2015, the total direct greenhouse gas emissions dynamic expressed in CO_2 equivalent, revealed a decreasing trend in the Republic of Moldova, reducing by circa 67.8 per cent: from 43.40 Mt CO_2 equivalent in 1990 to 13.95 Mt CO_2 equivalent in 2015 (Figure 2-5).

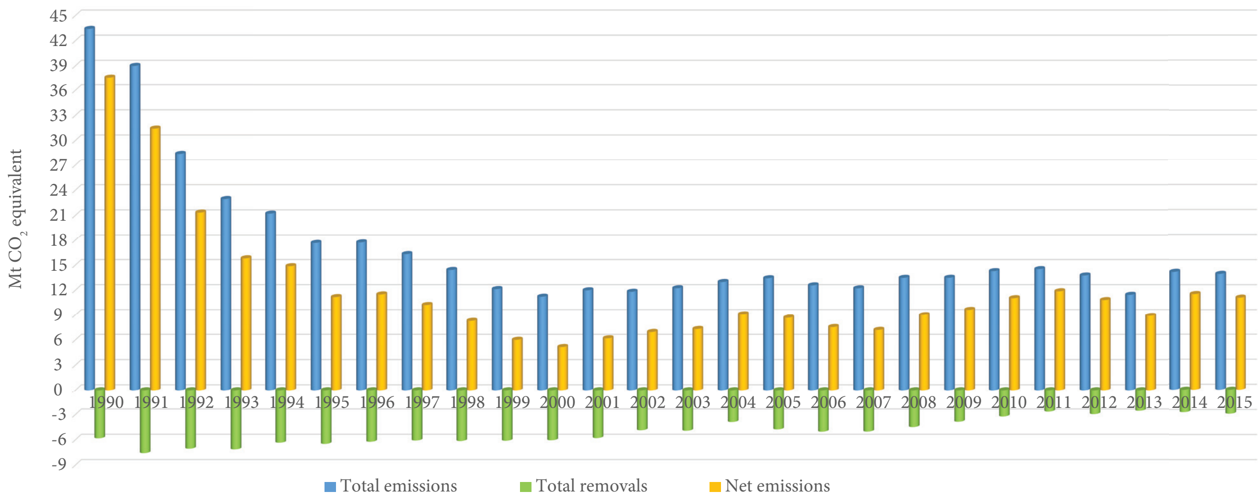


Figure 2-5: Greenhouse Gas Emission and Removals Trends in the RM within 1990-2015 time series

The most significant direct GHG emissions reductions have been registered under the following source categories: 4G "Harvested Wood Products" (-143.6 per cent), 1A5 "Other" (-98.0 per cent), 4C "Grassland" (-89.3 per cent), 1A1 "Energy Industry" (-78.6 per cent), 1A4 "Other Sectors" (-74.8 per cent), 3B "Manure Management" (-73.8 per cent), 3A "Enteric Fermentation" (-70.1 per cent) 1A2 "Manufacturing Industries and Construction" (-69.8 per cent), 2D "Non-energy Products from Fuels and Solvent Use" (-62.8 per cent), 2A "Mineral Industry" (-61.3 per cent), 4F "Other Land" (-60.1 per cent), 4E "Settlements" (-55.2 per cent), 5D "Wastewater Treatment and Discharge" (-52.9 per cent) and 1A3 "Transport" (-50.8 per cent).

Between 2014 and 2015, total direct GHG emissions decreased in the Republic of Moldova by circa 1.7 per cent. At the same time, emissions from certain source categories increased, in particular from: 4E "Settlements" (+106.4 per cent), 2C "Metal Industry" (+24.8 per cent), 2F "Product Uses as Substitutes for ODS" (+18.5 per cent), 1A2 "Manufacturing Industries and Construction" (+13.7 per cent), 1A3 "Transport" (+5.4 per cent) and 1A1 "Energy Industry" (+3.1 per cent). Also, removals from certain categories increased as well: 4B "Cropland" (+28.6 per cent) and 4C "Grassland" (+12.9 per cent).

2.5.2. Emission Trends by Gas

Within 1990 to 2015 periods, the total CO_2 emissions (without LULUCF) decreased by circa 73.1 per cent (from 34.8952 Mt in 1990 to 9.3956 Mt in 2015). CH_4 and N_2O emissions decreased by circa 49.8 per cent (from 5.7036 Mt CO_2 equivalent in 1990 to 2.8627 Mt CO_2 equivalent in 2015), respectively by 45.9 per cent (from 2.8013 Mt CO_2 equivalent in 1990 to 1.5145 Mt CO_2 equivalent in 2015) (Table 2-9).

Table 2-9: Direct GHG Emissions in the Republic of Moldova within 1990-2015, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2 (without LULUCF)	34.8952	31.0359	21.3191	16.0959	14.9803	11.5887	11.7678	10.7194	9.1852
CO_2 (with LULUCF)	29.0128	23.3966	14.2115	8.8982	8.5721	5.0373	5.4717	4.5634	2.9740
CH_4 (without LULUCF)	5.7036	5.2873	4.8574	4.5944	4.4237	4.1673	4.0936	3.7181	3.5328
CH_4 (with LULUCF)	5.7063	5.2897	4.8596	4.5974	4.4254	4.1695	4.0952	3.7208	3.5352
N_2O (without LULUCF)	2.8013	2.6646	2.2085	2.2483	1.7987	1.8892	1.8457	1.8593	1.6807
N_2O (with LULUCF)	2.8614	2.7241	2.2625	2.3064	1.8597	1.9563	1.9140	1.9239	1.7480
HFCs	NO	NO	NO	NO	NO	0.0046	0.0052	0.0060	0.0075
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	43.4000	38.9878	28.3850	22.9386	21.2027	17.6498	17.7123	16.3028	14.4061
Total (with LULUCF)	37.5804	31.4104	21.3336	15.8020	14.8571	11.1677	11.4861	10.2141	8.2647
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
CO_2 (without LULUCF)	7.2033	6.4504	7.0595	6.7827	7.4863	8.0163	8.3850	7.7398	8.1264
CO_2 (with LULUCF)	1.0176	0.3199	1.1837	1.8325	2.4732	4.0463	3.5447	2.6378	3.0328
CH_4 (without LULUCF)	3.3915	3.3209	3.3225	3.3681	3.2940	3.2622	3.3030	3.1688	2.9971
CH_4 (with LULUCF)	3.3939	3.3219	3.3237	3.3684	3.2940	3.2624	3.3032	3.1691	2.9988
N_2O (without LULUCF)	1.5195	1.4260	1.5813	1.6343	1.4182	1.6621	1.6839	1.5989	1.0149
N_2O (with LULUCF)	1.5906	1.4985	1.6631	1.7173	1.5039	1.7472	1.7596	1.6651	1.0826
HFCs	0.0086	0.0105	0.0129	0.0169	0.0237	0.0311	0.0422	0.0547	0.0698
PFCs	NO	NO	NO	NO	NO	NO	NO	0.0000	0.0000
SF_6	NO	NO	NO	NO	0.0000	0.0000	0.0001	0.0003	0.0004
Total (without LULUCF)	12.1228	11.2078	11.9762	11.8020	12.2221	12.9717	13.4141	12.5625	12.2087
Total (with LULUCF)	6.0108	5.1507	6.1833	6.9351	7.2948	9.0870	8.6497	7.5270	7.1845
	2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**%**
CO_2 (without LULUCF)	8.7930	9.0898	9.6570	9.8288	9.5065	8.4882	9.2609	9.3956	-73.1
CO_2 (with LULUCF)	4.2377	5.1696	6.3596	7.1157	6.4892	5.8716	6.5376	6.4910	-77.6
CH_4 (without LULUCF)	2.9837	2.8913	2.9134	2.9767	2.9285	2.8710	2.9367	2.8627	-49.8
CH_4 (with LULUCF)	2.9844	2.8917	2.9136	2.9769	2.9298	2.8719	2.9368	2.8634	-49.8
N_2O (without LULUCF)	1.6066	1.3994	1.5789	1.5772	1.1839	1.6509	1.8494	1.5145	-45.9
N_2O (with LULUCF)	1.6735	1.4671	1.6461	1.6461	1.2548	1.7196	1.9115	1.5730	-45.0
HFCs	0.0847	0.0932	0.1134	0.1195	0.1288	0.1376	0.1514	0.1794	NA
PFCs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	NA
SF_6	0.0005	0.0006	0.0007	0.0007	0.0008	0.0010	0.0011	0.0011	NA
Total (without LULUCF)	13.4685	13.4743	14.2635	14.5031	13.7486	11.4349	14.1995	13.9533	-67.8
Total (with LULUCF)	8.9809	9.6222	11.0334	11.8591	10.8034	8.8878	11.5384	11.1079	-70.4

Abbreviations: NA – Not Applicable; NO – Not Occurring

Halocarbons emissions (HFCs, PFCs) and sulphur hexafluoride (SF_6) emissions have been recorded beginning with 1995, considered as a starting year for monitoring F-gases (HFCs, PFCs and SF_6). Evolution of these emissions denotes a steady trend towards increase in the last years, though their share in the total national emissions structure is insignificant for now.

CO_2 continues to be the most important source of total national direct greenhouse gas emissions in the Republic of Moldova. Figure 2-6 reveals the variation of direct GHG emissions share by gas in the structure of total national emissions in 1990 and 2015.

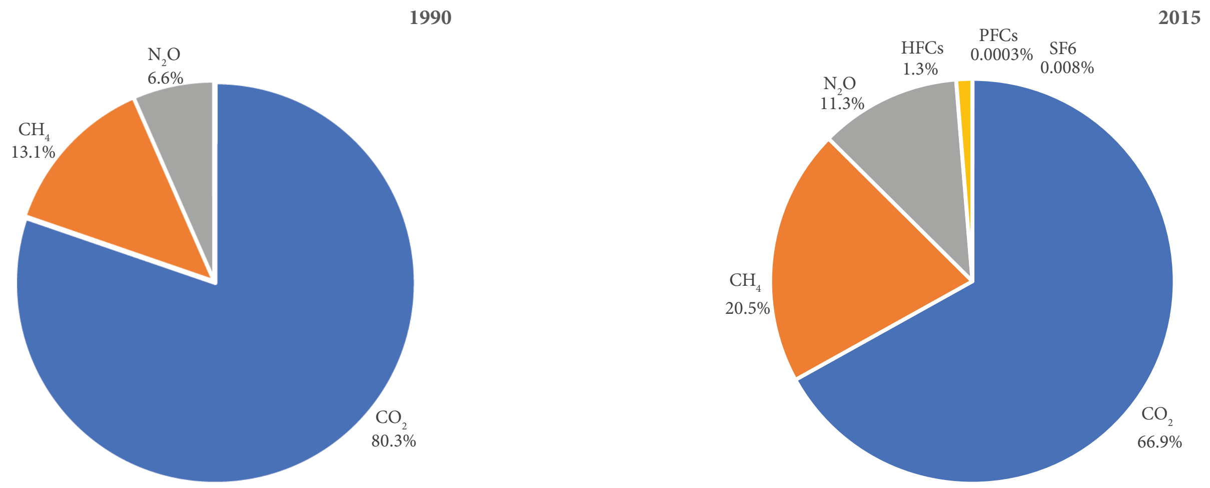


Figure 2-6: Direct GHGs share in the structure of total GHG emissions in the Republic of Moldova in 1990 and 2015 years

In 2015, the source categories having the biggest share in the total dioxide of carbon emissions in the Republic of Moldova were: 1A1 "Energy Industries" (4.1412 Mt or 44.1 per cent of the total), 1A3 "Transport" (2.1581 Mt or 23.0 per cent of the total), 4A "Forest Land" (-2.0273 Mt or -21.6 per cent of the total), 1A4 "Other Sectors" (1.7902 Mt or 19.1 per cent of the total), 4B "Cropland" (-0.7274 Mt or -7.7 per cent of the total), 1A2 "Manufacturing Industries and Constructions" (0.6656 Mt or 7.1 per cent of the total), 2A "Mineral Industry" (0.5097 Mt or 5.4 per cent of the total) and 4C "Grassland" (-0.3062 Mt or -3.3 per cent of the total) (Figure 2-7).

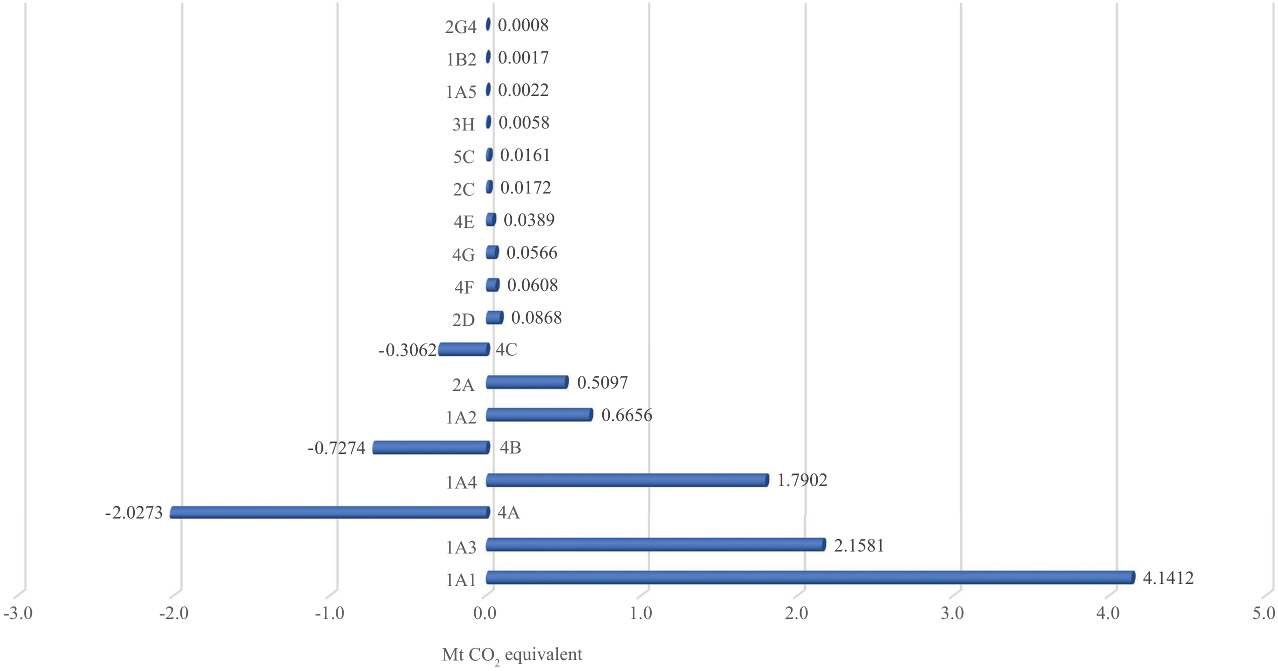


Figure 2-7: Source Categories of CO_2 in the Republic of Moldova in 2015

In 2015, the source categories having the biggest share in the total methane emissions in the Republic of Moldova were: 5A "Solid Waste Disposal" (1.0872 Mt CO_2 equivalent or 38.0 per cent of the total), 3A "Enteric Fermentation" (0.6546 Mt CO_2 equivalent or 22.9 per cent of the total), 1B2 "Fugitive Emissions from Oil and Natural Gas" (0.5666 Mt CO_2 equivalent or 19.8 per cent of the total), 5D "Wastewater Treatment and Discharge" (0.3542 Mt CO_2 equivalent or 12.4 per cent of the total), 1A4 "Other Sectors" (0.1089 Mt CO_2 equivalent or 3.8 per cent of the total) and 3B "Manure Management" (0.0704 Mt CO_2 equivalent or 2.5 per cent of the total) (Figure 2-8).

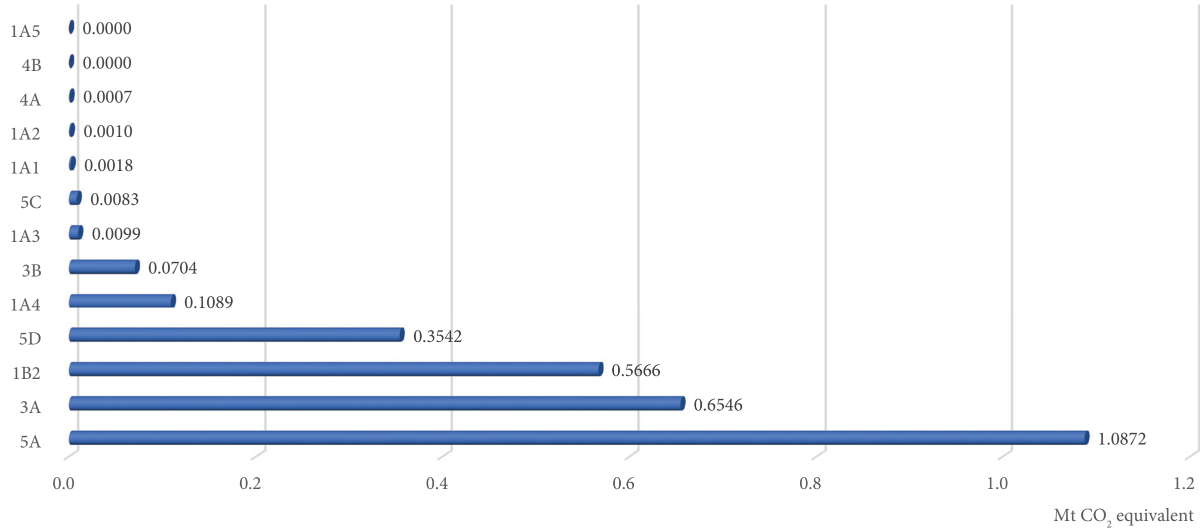


Figure 2-8: Source Categories of CH_4 in the Republic of Moldova in 2015

In 2015, the source categories having the biggest share in the total nitrous oxide emissions in the Republic of Moldova were: 3D "Agricultural Soils" (1.0318 Mt CO_2 equivalent or 68.1 per cent of the total), 3B "Manure Management" (0.3521 Mt CO_2 equivalent or 23.2 per cent of the total), 5D "Wastewater Treatment and Discharge" (0.0707 Mt CO_2 equivalent or 4.7 per cent of the total), 4B "Cropland" (0.0575 Mt CO_2 equivalent or 3.8 per cent), 1A3 "Transport" (0.0350 Mt CO_2 equivalent or 2.3 per cent of the total) and 1A4 "Other Sectors" (0.0169 Mt CO_2 equivalent or 1.1 per cent of the total) (Figure 2-9).

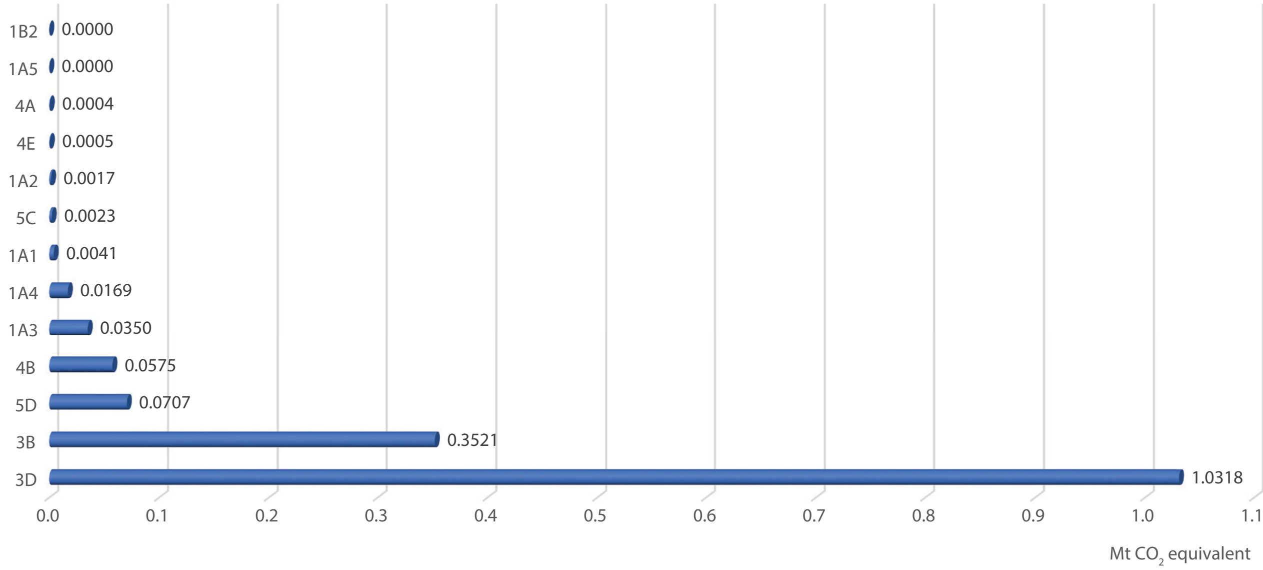


Figure 2-9: Source Categories of N_2O in the Republic of Moldova in 2015

2.5.3. Emission Trends by Sources

Emissions estimates were grouped into five large categories: (1) "Energy", (2) "Industrial Processes and Product Use", (3) "Agriculture", (4) "Land Use, Land-Use Change and Forestry" (LULUCF) and (5) "Waste". Interpretation of GHG emissions inventory results under LULUCF Sector is somewhat different from other sectors: positive figures indicate that this sector is a net source of emissions, while negative figures state that the sector is a net sink of CO_2 removals.

Within 1990-2015 periods, total GHG emissions in the Republic of Moldova tended to decrease, thus emissions under Energy Sector decreased by circa 72.6 per cent, Industrial Processes and Product Use – by circa 49.7 per cent, Agriculture – by 59.4 per cent, LULUCF – by 51.1 per cent, while from Waste Sector – by 22.2 per cent (Table 2-10).

Table 2-10: Direct Greenhouse Gas Emissions in the Republic of Moldova by Sector within 1990-2015, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Energy	34.6308	30.7803	21.3699	16.1330	15.1511	11.8855	12.1887	10.9476	9.4270
2. Industrial Processes and Product Use	1.5810	1.4026	0.8144	0.7331	0.5529	0.4535	0.4129	0.4550	0.3809
3. Agriculture	5.2106	4.8569	4.3977	4.2227	3.7517	3.5906	3.4009	3.1810	2.9467
4. LULUCF	-5.8197	-7.5773	-7.0514	-7.1366	-6.3455	-6.4821	-6.2262	-6.0886	-6.1414
5. Waste	1.9777	1.9479	1.8030	1.8497	1.7471	1.7202	1.7098	1.7191	1.6514
	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	7.4725	6.7878	7.3880	7.1323	7.8500	8.3637	8.6817	7.8533	8.0245
2. Industrial Processes and Product Use	0.3452	0.3190	0.3243	0.3770	0.4119	0.4897	0.5986	0.7092	0.9713
3. Agriculture	2.6892	2.5002	2.6728	2.7425	2.4246	2.5921	2.5765	2.4631	1.6847
4. LULUCF	-6.1121	-6.0570	-5.7928	-4.8670	-4.9273	-3.8846	-4.7644	-5.0355	-5.0242
5. Waste	1.6159	1.6007	1.5911	1.5503	1.5356	1.5262	1.5573	1.5369	1.5282
	2008	2009	2010	2011	2012	2013	2014	2015	%
1. Energy	8.6140	9.3023	9.8287	9.9961	9.6545	8.5633	9.3447	9.5049	-72.6
2. Industrial Processes and Product Use	1.0639	0.5601	0.6050	0.6985	0.7164	0.7703	0.8049	0.7951	-49.7
3. Agriculture	2.2384	2.0703	2.2497	2.2040	1.7758	2.2490	2.4879	2.1147	-59.4
4. LULUCF	-4.4876	-3.8521	-3.2301	-2.6440	-2.9451	-2.5470	-2.6610	-2.8454	-51.1
5. Waste	1.5522	1.5417	1.5801	1.6044	1.6018	1.5661	1.5619	1.5387	-22.2

Energy Sector is the most important source of total national direct GHG emissions, its share varying over the time series from 1990 through 2015 from 79.8 per cent and 68.1 per cent. Other relevant sources are represented by Agriculture, Waste and IPPU Sectors (Figure 2-10). During the entire period under review, the LULUCF Sector represented a net source of carbon removals. With the decrease of national direct GHG emissions, the importance of this sector in the structure of net GHG emissions at the national level increased significantly: in 1990 – the removals represented only circa 13.4 per cent of the total national GHG emissions, while in 2015 it represented already circa 20.4 per cent of the total.

Energy Sector

Energy-related activities are by far the largest source of GHG emissions in the Republic of Moldova. The Energy Sector includes emissions of all GHGs from fuel combustion (stationary and mobile combustion) for the primary purpose of delivering energy (94 per cent of total emissions per sector in 2015), as well as fugitive releases defined as intentional or unintentional releases of GHGs from the production, processing, transmission, storage, and delivery of fossil oil and natural gas (6 per cent of total emissions per sector in 2015) (Figure 2-11, Table 2-11).

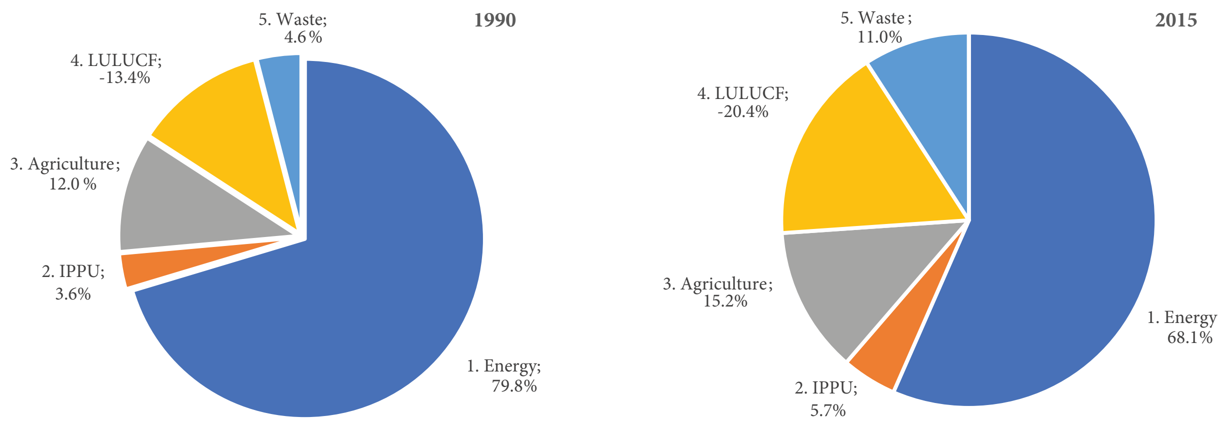


Figure 2-10: Sectoral Breakdown of the Republic of Moldova's total GHG Emissions in 1990 and 2015

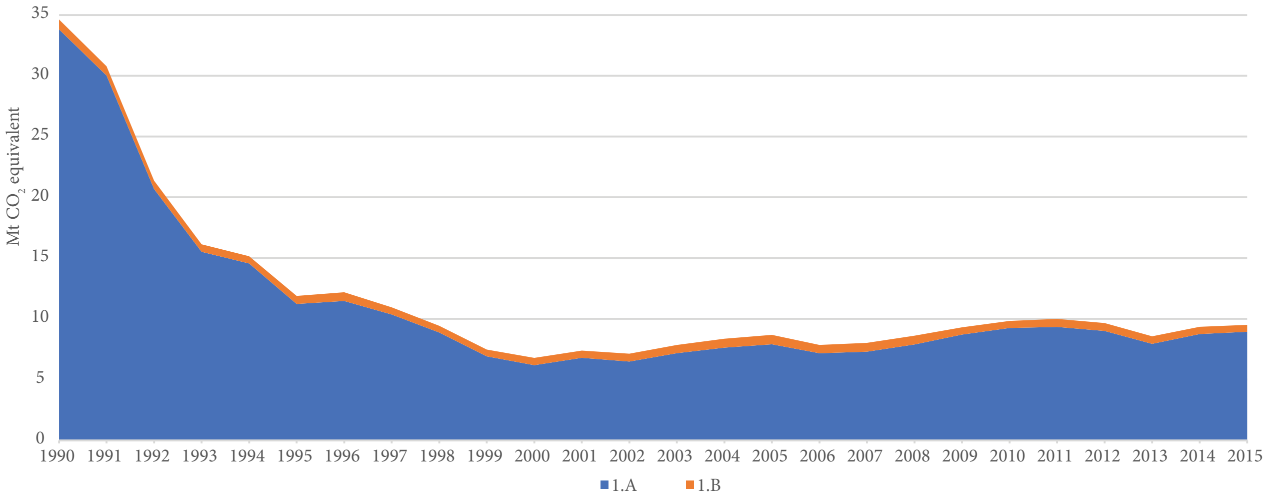


Figure 2-11: GHG Emissions from Energy Sector in the Republic of Moldova within 1990-2015 periods

Overall, these emissions accounted, in 2015 circa 68.1 per of total Republic of Moldova's direct GHG emissions. Between 1990 and 2015, total GHG emissions from Energy Sector decreased by circa 72.6 per cent: from 34.6308 Mt CO_2 equivalent in 1990 to 9.5049 Mt CO_2 equivalent in 2015.

Table 2-11: GHG Emissions from Energy Sector within 1990-2015 periods, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
1. Energy	**34.6308**	**11.8855**	**6.7878**	**8.6817**	**9.8287**	**9.9961**	**9.6545**	**8.5633**	**9.3447**	**9.5049**
1A. Fuel Combustion	**33.8179**	**11.2237**	**6.1868**	**7.9052**	**9.2476**	**9.3344**	**9.0023**	**7.9417**	**8.7477**	**8.9367**
1A.1. Energy Industries	19.3983	6.9044	3.1593	3.2333	4.5976	4.1880	4.1971	3.3164	4.0215	4.1471
1A.2. Manufacturing Industries and Construction	2.2138	0.4650	0.5380	0.6049	0.5411	0.6015	0.5652	0.6016	0.5876	0.6683
1A.3. Transport	4.4818	1.5229	0.9488	1.7680	2.0537	2.1643	1.9056	2.0150	2.0903	2.2030
1A.4. Other Sectors	7.6084	2.2128	1.5143	2.2641	2.0310	2.3587	2.3266	2.0048	2.0461	1.9161
1A.5. Other	0.1156	0.1186	0.0263	0.0350	0.0243	0.0219	0.0078	0.0038	0.0023	0.0023
1B. Fugitive Emissions from Fuels	**0.8129**	**0.6618**	**0.6010**	**0.7766**	**0.5811**	**0.6617**	**0.6522**	**0.6216**	**0.5970**	**0.5683**
1B.1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1B.2. Oil and Natural Gas	0.8129	0.6618	0.6010	0.7766	0.5811	0.6617	0.6522	0.6216	0.5970	0.5683
1C. CO_2 Transport and Storage	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Abbreviations: NO – Not Occurring.

The 1A1 "Energy Industries" contribute more than any other category to the Republic of Moldova's emissions under Energy Sector, accounting for circa 43.6 per cent of the total per sector in 2015 (56.0 per cent in 1990). Other relevant categories are represented by 1A3 "Transport" accounting for circa 23.2 per cent of the total per sector (12.9 per cent in 1990), 1A4 "Other Sectors", accounting for circa 20.2 per cent of the total (22.0 per cent in 1990) and 1A2 "Manufacturing Industries and Construction" accounting for circa 7.0 per cent of the total (6.4 per cent in 1990) (Figure 2-12).

Industrial Processes and Product Use Sector

The IPPU Sector represents an important GHG emission source in the Republic of Moldova that includes emissions generated by non-energy industrial activities. In 2015, this sector accounted for circa 5.7 per cent of the total national GHG emissions (3.6 per cent in 1990). During 1990-2015 time periods, total sectoral GHG emissions decreased by circa 49.7 per cent: from 1.5810 Mt CO_2 equivalent in 1990 to 0.7951 Mt CO_2 equivalent in 2015 (Figure 2-13).

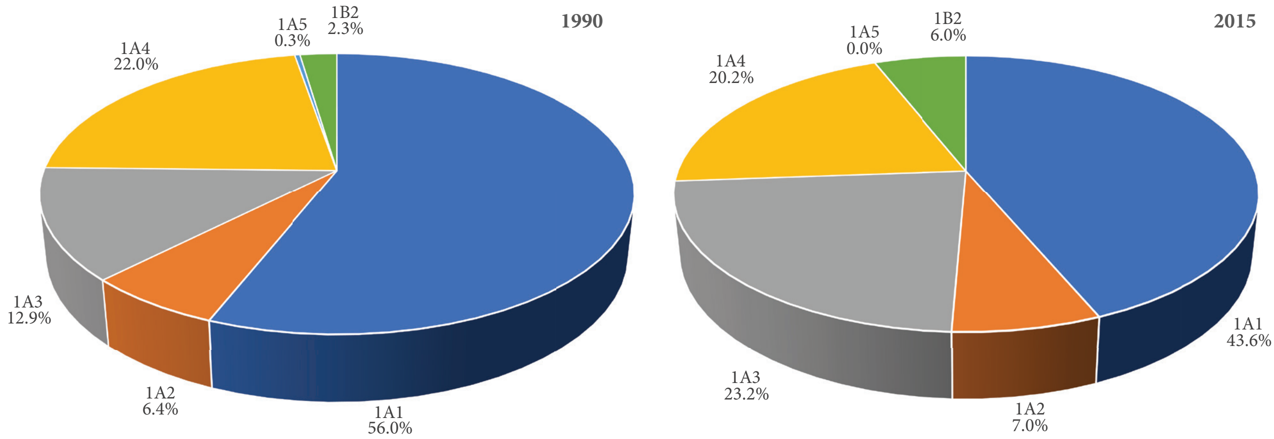


Figure 2-12: Energy Sector Greenhouse Gas Sources in the Republic of Moldova in 1990 and 2015

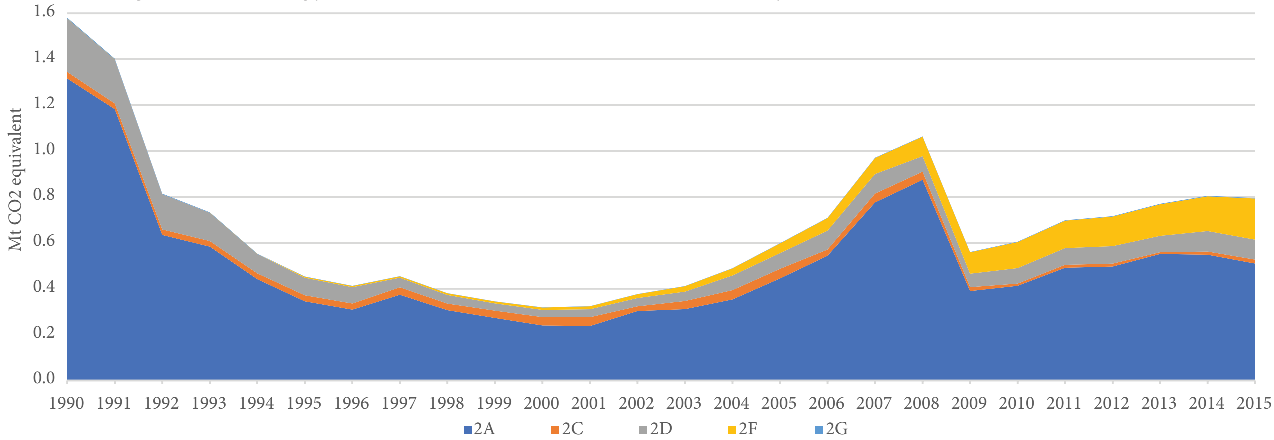


Figure 2-13: Total GHG Emissions from IPPU in the Republic of Moldova within 1990-2015 periods

Between 2008 and 2009, the respective emissions decreased by 47.4 per cent as a consequence of the global and regional economic crises that significantly affected the industrial sector in the Republic of Moldova. Subsequently, in 2010-2014 years, direct sectoral GHG emissions tended to increase slowly, in particular due to the increase in cement, lime, glass, steel production, as well as due to the increased use of halocarbons. Between 2014 and 2015, total GHG emissions from this sector decreased by 1.2 per cent (Table 2-12).

Table 2-12: Direct GHG Emissions from IPPU within 1990-2015, Mt CO_2 equivalent

Source Category	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
2. Industrial Processes and Product Use	**1.5810**	**0.4535**	**0.3190**	**0.5986**	**0.6050**	**0.6985**	**0.7164**	**0.7703**	**0.8049**	**0.7951**
A. Mineral Industry	1.3161	0.3451	0.2400	0.4448	0.4127	0.4915	0.4968	0.5516	0.5483	0.5097
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Industry	0.0285	0.0262	0.0363	0.0419	0.0097	0.0129	0.0127	0.0077	0.0138	0.0172
D. Non-energy Products from Fuels and Solvent Use	0.2332	0.0765	0.0314	0.0685	0.0675	0.0728	0.0762	0.0714	0.0894	0.0868
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Uses as Substitutes for ODS	NO	NO	NO	NO	0.1134	0.1195	0.1288	0.1376	0.1514	0.1794
G. Other Product Manufacture and Use	0.0032	0.0011	0.0009	0.0011	0.0016	0.0019	0.0019	0.0022	0.0021	0.0019
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Abbreviations: NA – Not Applicable; NO – Not Occurring

The most important source of emission in this sector is represented by 2A1 "Cement Production", with a share of circa 55.8 per cent of the total sectoral emissions in 2015 (61.5 per cent in 1990). Other relevant sources in 2015 were represented by 2F2 "Foam Blowing Agents" with a share of 12.8 per cent of the total, 2D3 "Solvent Use" - 10.0 per cent of the total (12.9 per cent in 1990), 2F1 "Refrigeration and Air Conditioning" - circa 9.7 per cent of the total, 2A3 "Glass Production" - 3.5 per cent of the total (1.6 per cent in 1990), 2A2 "Lime Production" - 2.7 per cent of the total (14.7 per cent in 1990), 2C1 „Iron and Steel Production" - 2.2 per cent of the total (1.8 per cent in 1990) and 2A4 "Other Process Uses of Carbonates" - 2.1 per cent of the total (5.5 per cent in 1990) (Figure 2-14).

Agriculture Sector

The Agriculture Sector represents an important source of direct GHG emissions in the Republic of Moldova: CH_4 emissions, in particular from "Enteric fermentation" (category 3A) and "Manure management" (category 3B); N_2O emissions from "Manure management" (category 3B) and "Agricultural soils" (category 3D), respectively CO_2 emissions from "Urea application" (category 3H). In the

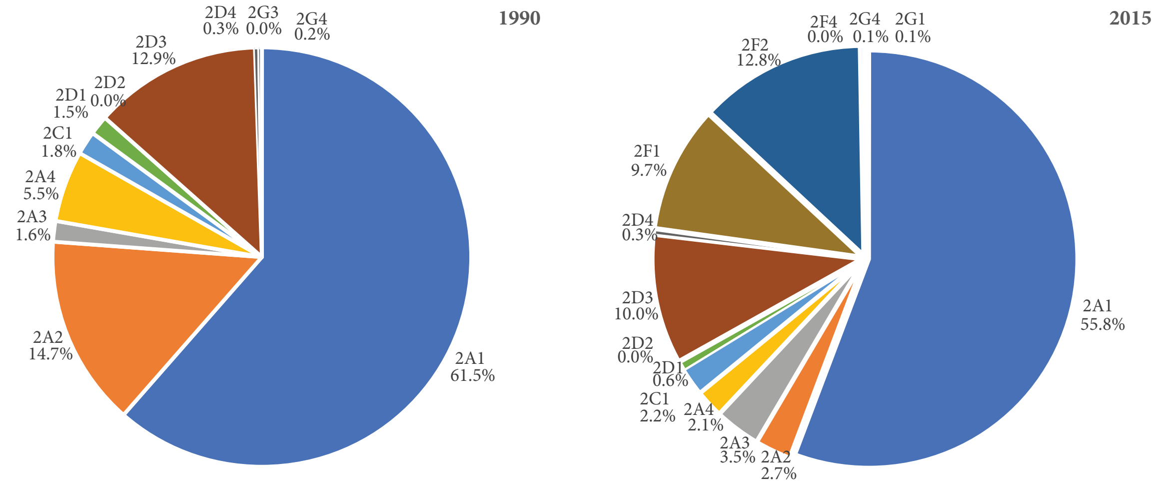


Figure 2-14: Breakdown of IPPU's GHG Emissions by Category in the RM in 1990 and 2015

Republic of Moldova there are no registered emissions from 3C "Rice cultivation", 3E "Prescribed burning of savannas", 3G "Liming", 3I "Other carbon-containing fertilizers" and 3J "Other", as for the emissions from 3F "Field burning of agricultural residues", these are monitored in the LULUCF Sector, under the category 4B "Cropland".

In 2015, Agriculture Sector accounted for circa 15.2 per cent of the total national direct GHG emissions (12.0 per cent in 1990). Between 1990 and 2015 total GHG emissions originated from this sector decreased by circa 59.4 per cent: from 5.2106 Mt CO_2 equivalent in 1990 to 2.1147 Mt CO_2 equivalent in 2015 (Table 2-13), in particular, due to a sharp drop in such indicators as: domestic livestock and poultry population, amounts of synthetic nitrogen and organic fertilizers applied to soils, amounts of agricultural crop residues returned to soils, carbon losses from mineral soils and changes of tillage practices.

Table 2-13: Direct GHG Emissions from Agriculture Sector within 1990-2015, Mt CO_2 equivalent

Source Categories	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
3. Agriculture	**5.2106**	**3.5906**	**2.5002**	**2.5765**	**2.2497**	**2.2040**	**1.7758**	**2.2490**	**2.4879**	**2.1147**
A. Enteric fermentation	2.1907	1.6207	1.0857	0.9269	0.7126	0.6714	0.6343	0.6438	0.6816	0.6546
B. Manure management	1.6114	0.9274	0.5494	0.5537	0.4985	0.4575	0.4214	0.3982	0.4357	0.4224
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	1.4078	1.0425	0.8647	1.0957	1.0369	1.0714	0.7145	1.2028	1.3603	1.0318
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
G. Liming	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Urea application	0.0006	0.0001	0.0004	0.0002	0.0017	0.0037	0.0056	0.0042	0.0102	0.0058
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Abbreviations: IE – Included Elsewhere; NO – Not Occurring.

Between 2014 and 2015, direct GHG emissions from Agriculture Sector decreased by circa 15.0 per cent (Figure 2-15), in particular as a result of the decreasing use of synthetic nitrogen fertilizers and the decrease of livestock population.

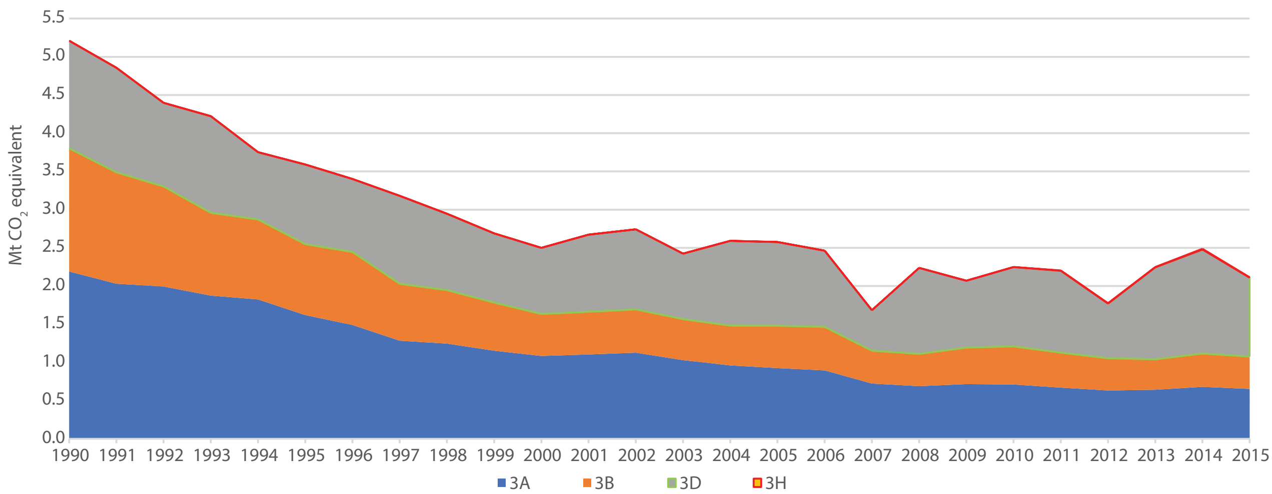


Figure 2-15: Total Direct GHG Emissions from Agriculture Sector in the RM within 1990-2015 periods

In 2015, the largest source of emission was 3D "Agricultural Soils", accounting for circa 48.8 per cent of the total per sector (27.0 per cent in 1990). Other relevant sources are represented by 3A "Enteric Fermentation" accounting for 31.0 per cent of the total (42.0 per cent in 1990) and 3B "Manure Management" accounting for circa 20.0 per cent of the total (30.9 per cent in 1990). The share of 3H "Urea Application" category is insignificant at the sectoral level (Figure 2-16).

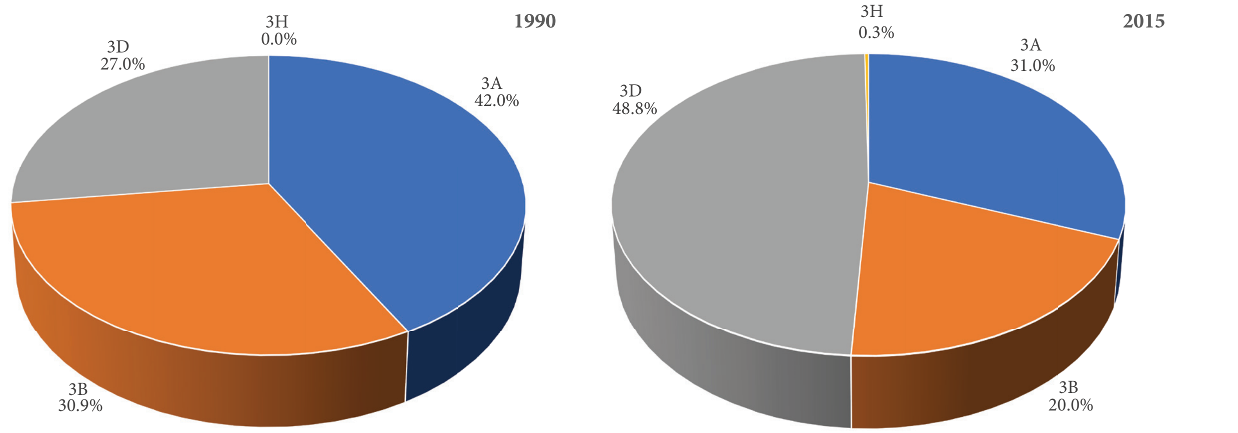


Figure 2-16: Breakdown of Agriculture GHG Emissions by Category in the RM in 1990 and 2015

Land Use, Land-Use Change and Forestry Sector

Between 1990 and 2015, the LULUCF Sector represented a sink of net carbon removals. Within the respective period, net CO_2 removals registered a decreasing trend, reducing by circa 51.1 per cent, from -5.8197 Mt CO_2 equivalent recorded in 1990 to -2.8454 Mt CO_2 equivalent in 2015 (Table 2-14, Figure 2-17).

Table 2-14: Emissions and Removals in LULUCF Sector within 1990-2015 periods, Mt CO_2 equivalent

Source Category	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
4. LULUCF	**-5.8197**	**-6.4821**	**-6.0570**	**-4.7644**	**-3.2301**	**-2.6440**	**-2.9451**	**-2.5470**	**-2.6610**	**-2.8454**
A. Forest Land	-2.5434	-2.0258	-2.2883	-2.3903	-2.4895	-2.3731	-2.2060	-2.0537	-2.0192	-2.0262
B. Cropland	-0.5189	-1.8546	-1.2141	-0.4154	-0.3338	-0.3333	-0.4068	-0.3909	-0.5207	-0.6699
C. Grassland	-2.8503	-3.0885	-2.8443	-2.2408	-0.5558	-0.4427	-0.4261	-0.2775	-0.2712	-0.3062
D. Wetlands	-0.0174	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
E. Settlements	0.0879	0.1109	0.1030	0.0557	0.0473	0.0633	0.0123	0.0123	0.0191	0.0394
F. Other Land	0.1525	0.3927	0.1701	0.2816	0.1317	0.4661	0.0873	0.0873	0.0705	0.0608
G. Harvested Wood Products	-0.1301	-0.0168	0.0166	-0.0552	-0.0300	-0.0243	-0.0059	0.0754	0.0605	0.0566
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Abbreviations: IE – Included Elsewhere; NO – Not Occurring.

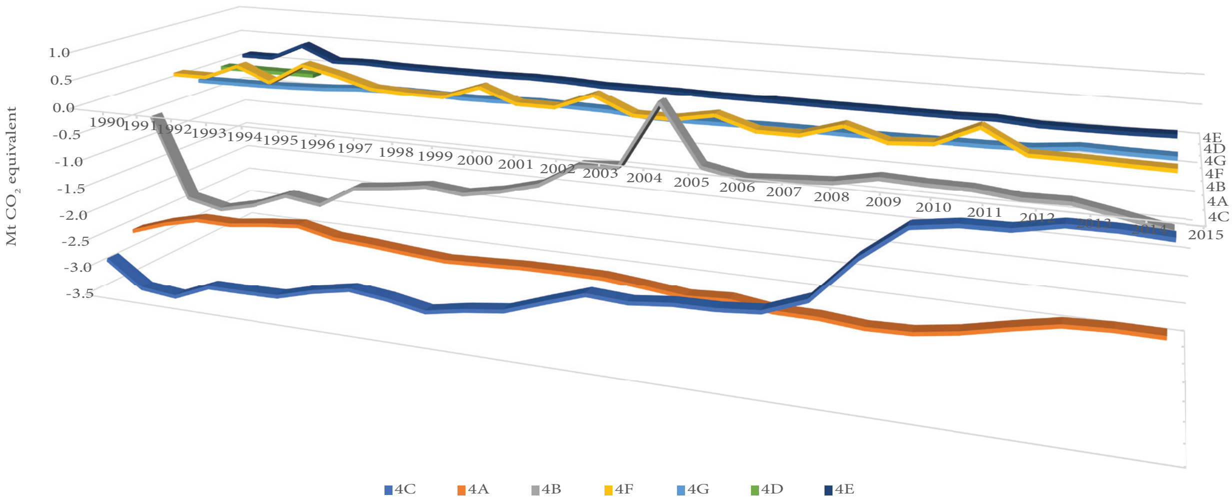


Figure 2-17: Direct GHG Emissions/Removals in LULUCF Sector by Source/Sink Categories

This situation can be explained, in particular, due to changes in the use and management of agricultural soils (category 4B), that contributed to the substantial decrease of organic carbon from the agricultural soils[32], thus changing the humus balance from a positive one to a negative and/or profoundly negative balance. This process was also influenced by some changes in the maintenance and use of forests (category 4A), authorized increased amounts of harvested wood, substantial increase of illegal fellings, increased conversion of forest land into cropland etc.

[32] The organic carbon and nitrogen in soil are highly dependent within the humus content in soil; carbon losses through the oxidation process due to changes in the use and management of agricultural soils are accompanied by the simultaneous mineralization (biochemical decomposition) of nitrogen.

In the Republic of Moldova, in 2015, the largest source of carbon removals under LULUCF Sector was 4A „Forest Land” (forests, protective forests etc.) accounting for 64.1 per cent (40.4 per cent in 1990), followed by 4B „Cropland” (lands covered with wood vegetation – multiannual plantations as well as the agricultural soils), accounting for 21.2 per cent (8.2 per cent in 1990), respectively from category 4C „Grassland” accounting for circa 9.7 per cent of the total (45.2 per cent in 1990) (Figure 2-18).

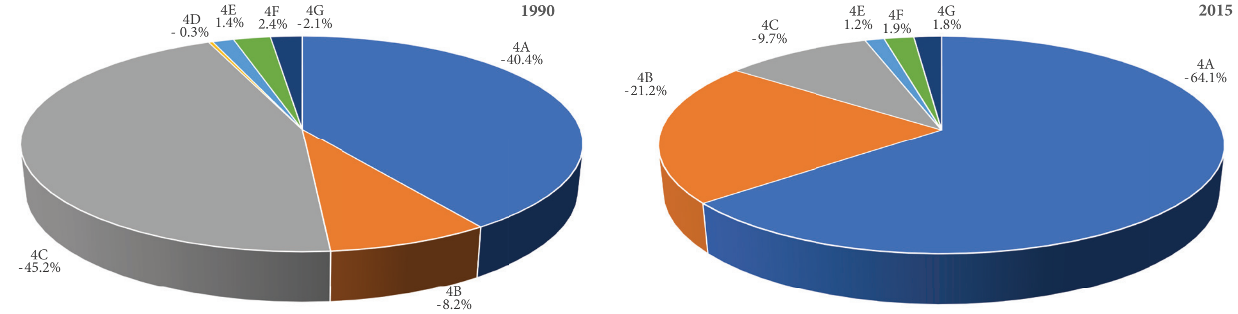


Figure 2-18: Breakdown of GHG Emissions and Removals by Source and Sink Categories in LULUCF Sector in 1990 and 2015

Waste Sector

Waste Sector is an important source of GHG emissions in the Republic of Moldova: CO_2 emissions from Incineration and Open Burning of Waste (category 5C), methane emissions from “Solid Waste Disposal” (category 5A), “Incineration and Open Burning of Waste” (category 5C) and “Wastewater Treatment and Discharge” (category 5D), respectively N_2O emissions from “Incineration and Open Burning of Waste” (category 5C) and “Wastewater Treatment and Discharge” (human manure) (category 5D). At the moment, in RM there are no any emissions registered in 5B “Biological Treatment of Solid Waste” and 5E “Other” categories.

In 2015, Waste Sector accounted for circa 11.0 per cent of the total national direct GHG emissions (4.6 per cent in 1990). Within 1990-2015 periods, total GHG emissions from this sector decreased by circa 22.2 per cent: from 1.9777 Mt CO_2 equivalent in 1990 to 1.5387 Mt CO_2 equivalent in 2015 (Table 2-15). Between 2014 and 2015, direct GHG emissions from this sector decreased by circa 1.5 per cent.

Table 2-15: GHG Emissions from Waste Sector within 1990-2015 periods, Mt CO_2 equivalent

Source Category	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
5. Waste	**1.9777**	**1.7202**	**1.6007**	**1.5573**	**1.5801**	**1.6044**	**1.6018**	**1.5661**	**1.5619**	**1.5387**
A. Solid Waste Disposal	1.0467	1.2092	1.1695	1.0643	1.1379	1.1551	1.1436	1.0848	1.0831	1.0872
B. Biological Treatment of Solid Waste	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
C. Incineration and Open Burning of Waste	0.0283	0.0283	0.0280	0.0274	0.0270	0.0271	0.0270	0.0270	0.0269	0.0267
D. Wastewater Treatment and Discharge	0.9027	0.4827	0.4032	0.4656	0.4153	0.4223	0.4312	0.4544	0.4520	0.4248
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Abbreviations: NE – Not Estimated; NO – Not Occurring.

Reduction of total GHG emissions from the Waste Sector, in particular until 2000, could be explained by the economic decline that occurred in the Republic of Moldova during the respective period, by a significant drop in the wellbeing of population, and respectively, capacity to generate wastes. At the same time, starting with 2005, there has been a slight growing trend of direct GHG emissions from the “Waste Sector” (Figure 2-19).

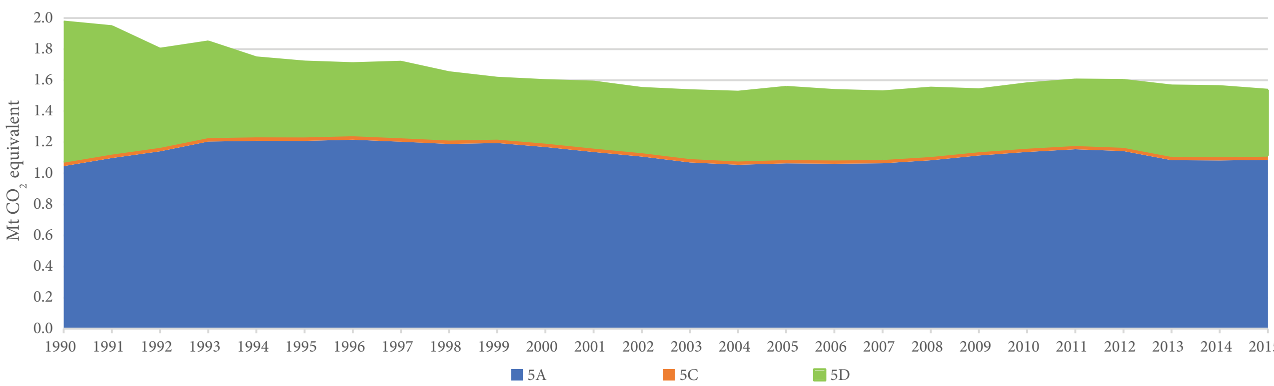


Figure 2-19: Total Waste Sector GHG Emissions Trends in the RM within 1990-2015 periods

In 2015, the largest source of GHG emissions within the Waste Sector was 5A “Solid Waste Disposal”, accounting for circa 70.7 per cent of the total sectoral emissions (52.9 per cent in 1990), followed by 5D “Wastewater Treatment and Discharge”, accounting for circa 27.6 per cent of the total (45.6 per cent in 1990), respectively from category 5C “Incineration and Open Burning of Waste”, with a share of circa 1.7 per cent of the total (1.4 per cent in 1990) (Figure 2-20).

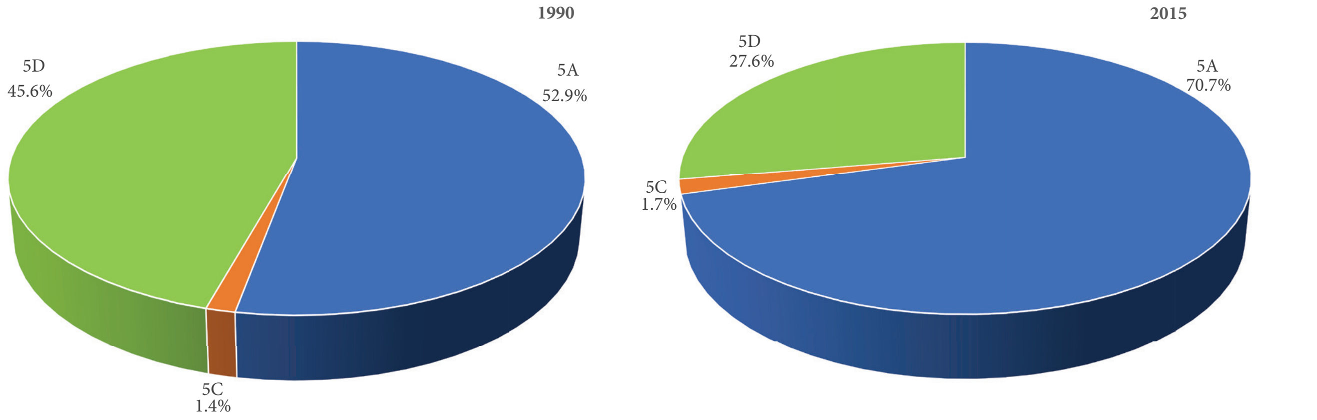


Figure 2-20: Breakdown of Waste GHG Emissions by Category in the RM in 1990 and 2015

2.5.4. Emission Trends for Ozone and Aerosol Precursors

Though not considered greenhouse gases, photochemically active gases like carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC), have an indirect global warming effect. These gases are considered as ozone precursors influencing the formation and destruction of tropospheric and stratospheric ozone. In particular, they are emitted from transportation, fossil fuel combustion, consumption of solvents and other household products, etc. Thus, the national GHG inventory of the Republic of Moldova includes emissions of the following ozone and aerosol precursors: NOx, CO, NMVOC and SO_2.

Between 1990 and 2015, total nitrogen oxides emissions decreased by circa 68.5 per cent: from 137.1930 kt in 1990 to 43.2178 kt in 2015; total carbon monoxide emissions decreased by circa 61.5 per cent: from 439.0588 kt in 1990 to 169.0056 kt in 2015, non-methane volatile organic compounds emissions decreased by circa 61.6 per cent: from 183.0223 kt in 1990 to 70.3063 kt in 2015, while sulphur dioxide emissions decreased by circa 92.6 per cent: from 294.2491 kt in 1990 to 21.8899 kt in 2015 (Table 2-16).

Table 2-16: Ozone and Aerosol Precursors (NO_x, CO and NMVOC) and SO_2 Emission Trends in the RM within 1990-2015 periods, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998
NO_x	137.1930	124.3404	78.2802	62.5812	58.3531	49.3980	47.1068	43.6544	36.5540
CO	439.0588	371.4113	173.3580	146.0255	141.2352	139.9312	141.2185	149.7084	126.2339
NMVOC	183.0223	155.2900	105.8855	87.4951	67.2505	66.0356	62.3036	49.5601	43.5191
SO_2	294.2491	244.2434	169.7527	137.1709	100.3805	59.5089	58.3896	33.5716	26.3976
	1999	2000	2001	2002	2003	2004	2005	2006	2007
NO_x	26.7366	25.2064	27.4804	28.7878	31.1685	33.2657	34.5095	32.6202	35.0212
CO	85.4601	84.3441	87.4949	107.8300	128.7661	131.1277	133.5524	128.7570	127.6376
NMVOC	31.4470	31.0555	33.2102	38.5332	43.1876	56.0942	59.3127	63.1443	64.1206
SO_2	13.4319	9.5508	9.1867	10.3037	12.3242	11.1911	10.9459	11.2334	9.2497
	2008	2009	2010	2011	2012	2013	2014	2015	%
NO_x	37.5402	37.5455	40.5531	41.2474	38.4362	37.4587	41.2859	43.2178	-68.5
CO	133.1239	130.8874	130.1470	136.8043	122.5016	121.5024	160.1651	169.0056	-61.5
NMVOC	58.5079	52.8153	57.0391	60.7789	59.7134	58.9806	72.1587	70.3063	-61.6
SO_2	15.7014	19.4449	19.0192	17.8646	16.9376	19.8122	22.5976	21.8899	-92.6

In 2015, the source categories having the biggest share in the total nitrogen oxides emissions in the Republic of Moldova were: 1A3 "Transport" (21.9992 kt or 50.9 per cent of the total), 1A1 "Energy Industries" (11.2794 kt or 26.1 per cent of the total), 1A4 "Other Sectors" (6.2097 kt or 14.4 per cent of the total), 1A2 "Manufacturing Industries and Constructions" (1.9040 kt or 4.4 per cent of the total) and 2A "Mineral Industry" (1.5815 kt or 3.7 per cent of the total) (Figure 2-21).

In 2015, the source categories having the biggest share in the total carbon monoxide emissions in the Republic of Moldova were: 1A3 "Transport" (90.0932 kt or 53.1 per cent of the total), 1A4 "Other Sectors" (70.2315 kt or 41.4 per cent of the total), 5C "Incineration and Open Burning of Waste" (2.7979 kt or 1.6 per cent of the total), 1A2 "Manufacturing Industries and Constructions" (2.2239 kt or 1.3 per cent of the total), 1A1 "Energy Industries" (1.4073 kt or 0.8 per cent of the total), 2A "Mineral Industry" (1.2964 kt or 0.8 per cent of the total), 2C "Metal Industry" (0.7325 kt or 0.4 per cent of the total) and 4A "Forest Land" (forest fires) (0.6041 kt or 0.4 per cent of the total) (Figure 2-22).

In 2015, the source categories having the biggest share in the total non-methane volatile organic compounds emissions in the RM were: 2D "Non-energy Products from Fuels and Solvent Use" (36.0209 kt or 51.2 per cent of the total), 1A3 "Transport" (17.1297 kt or 24.4 per cent of the total), 1A4 "Other Sectors" (8.5288 kt or 12.1 per cent of the total), 2H "Other" (food and alcoholic beverages) (4.7339 kt or 6.7 per cent of the total), 5A "Solid Waste Disposal" (2.2355 kt or 3.2 per cent of the total), 1B2 "Fugitive Emissions from Fuels" (0.7158 kt or 1.0 per cent of the total) 2G "Other Product Manufacture and Use" (0.3564 kt or 0.5 per cent of the total) and 1A1 "Energy Industries" (0.3526 kt or 0.5 per cent of the total) (Figure 2-23).

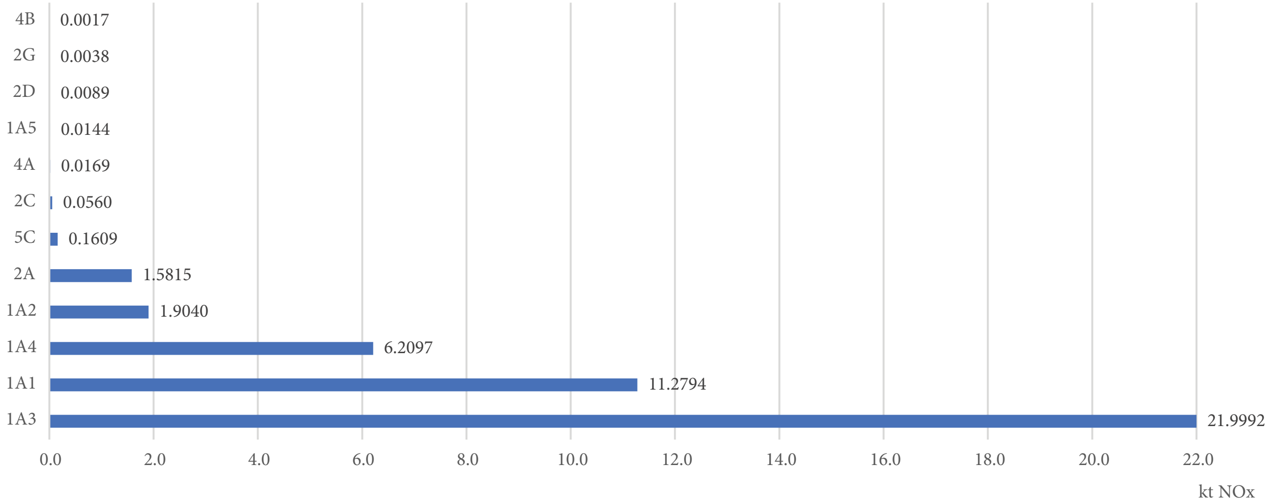


Figure 2-21: Source Categories of NO_x in the Republic of Moldova in 2015

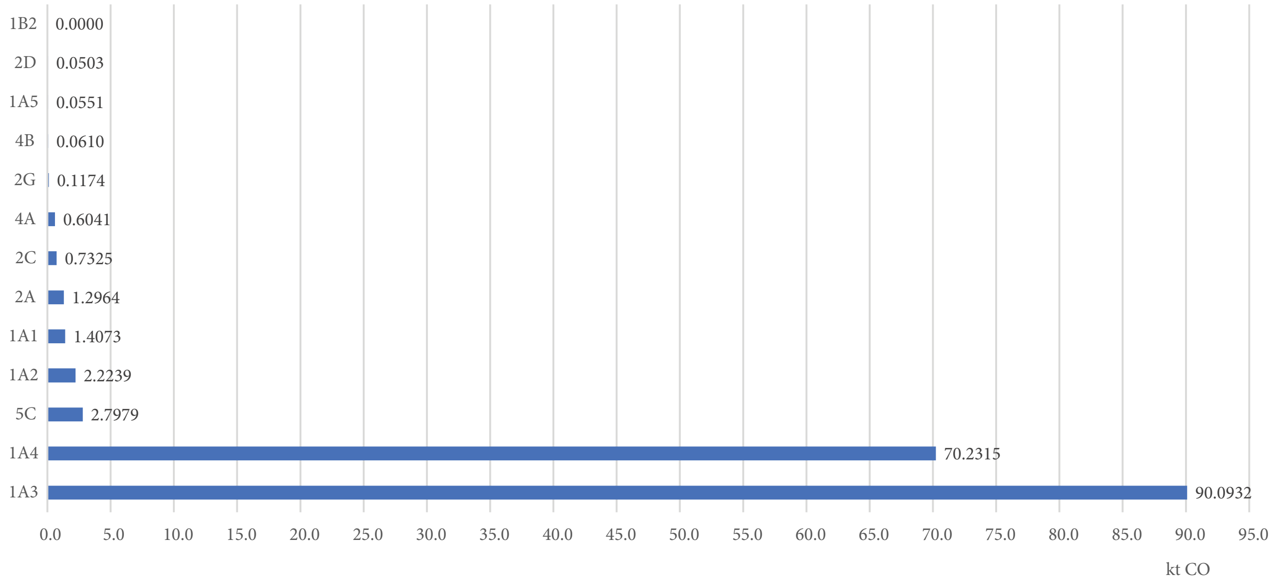


Figure 2-22: Source Categories of CO in the Republic of Moldova in 2015

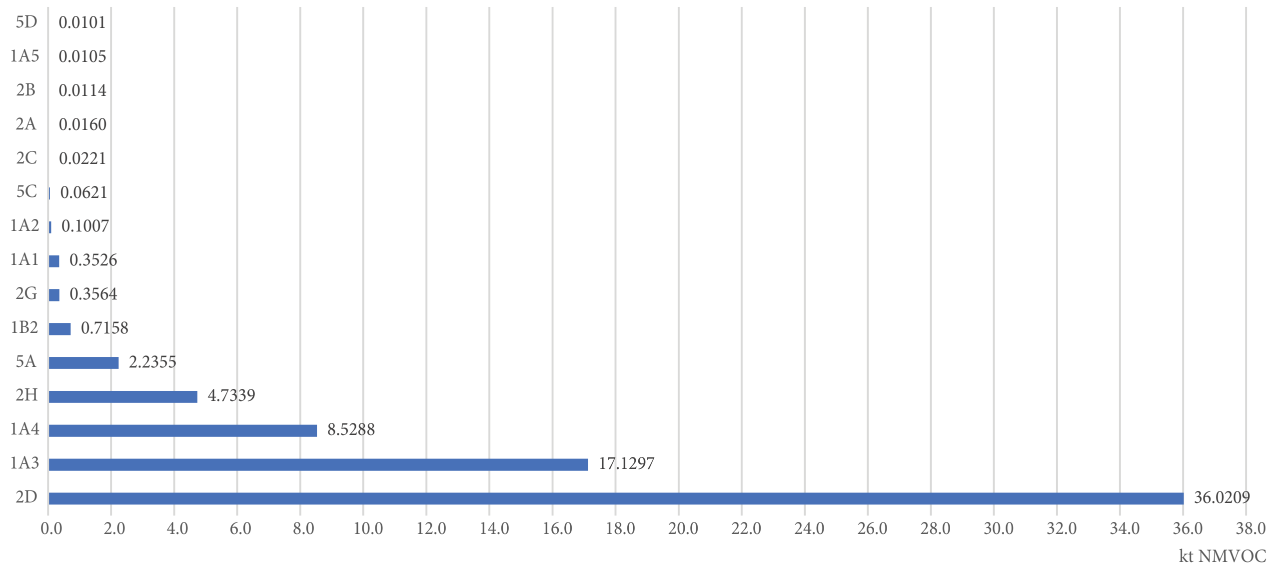


Figure 2-23: Source Categories of NMVOC in the Republic of Moldova in 2015

In 2015, the source categories having the biggest share in the total sulphur dioxide emissions in the Republic of Moldova were: 1A4 "Other Sectors" (9.3297 kt or 42.6 per cent of the total), 1A1 "Energy Industries" (5.9151 kt or 27.0 per cent of the total), 1A3 "Transport" (3.3575 kt or 15.3 per cent of the total), 1A2 "Manufacturing Industries and Constructions" (2.5810 kt or 11.8 per cent of the total) and 2A "Mineral Industry" (0.6478 kt or 3.0 per cent of the total) (Figure 2-24).

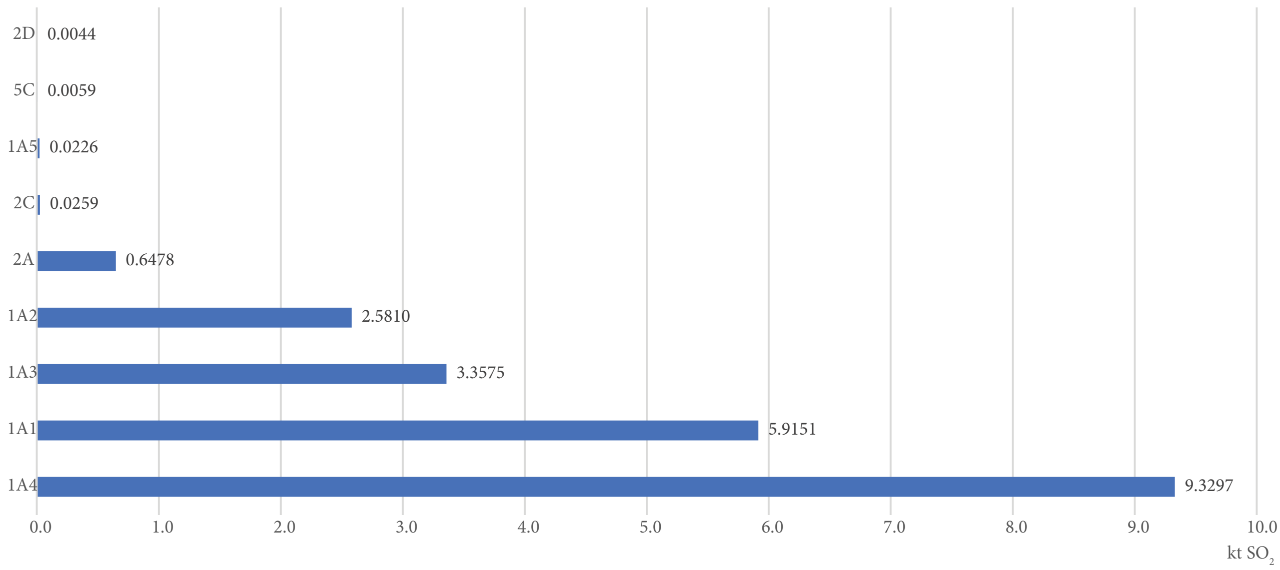
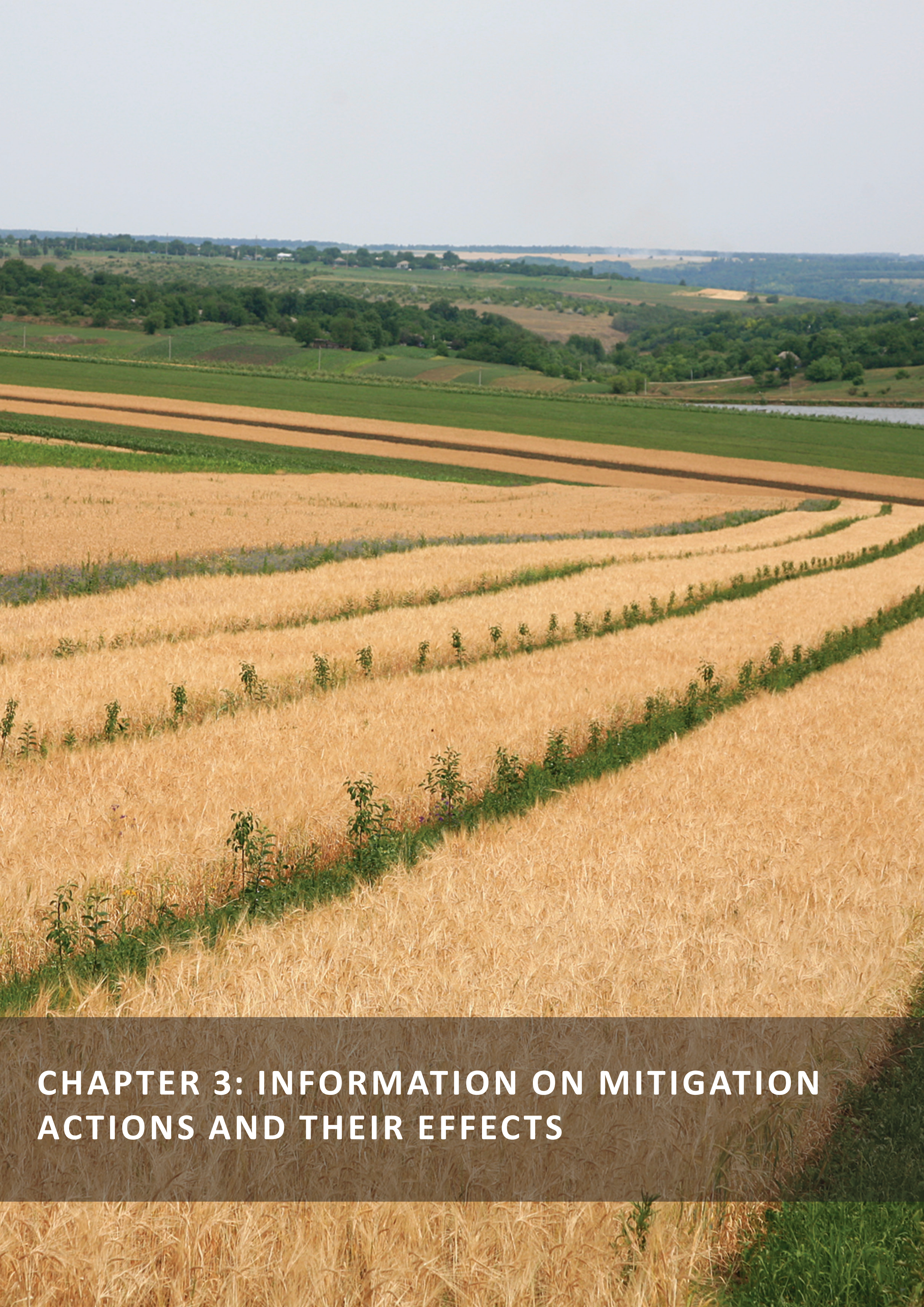


Figure 2-24: Source Categories of SO_2 in the Republic of Moldova in 2015



CHAPTER 3: INFORMATION ON MITIGATION ACTIONS AND THEIR EFFECTS

CHAPTER 3: INFORMATION ON MITIGATION ACTIONS AND THEIR EFFECTS

3.1. Introduction

Among the countries of the world, the RM stands out by a very low level of CO_2 emissions per capita. In 2013, it was 1.4 t CO_2/inhabitant[33], decreasing by almost seven times compared to 1990, when this indicator was 9.1 t CO_2/inhabitant. For comparison, in 2013 Romania registered 3.5, Russia 12.5, Latvia 3.5; Lithuania 4.3; USA 16.1; United Kingdom 7.1 t CO_2/inhabitant34. Behind such a low level of CO_2 emissions in the Republic of Moldova is mainly the economic regression that took place during the 25 years since the declaration of independence (August 27, 1991). With a GDP of US$ (PPP) 5,057 per capita (2016), the RM continues to remain yet as one of the lowest-income country in Europe. It is expected that further economic growth of the country will be difficult to achieve without the increase of the GHG emissions level, among others. At the same time, during the process of economic growth, it is important to ensure implementation of advanced technologies and policies resulting in the lowest possible level of emissions. In the recent period of time the leadership of the country successfully abided by this principle, adopting and implementing a whole set of legislation looking towards energy efficiency, use of renewable sources of energy, soil conservation, sustainable waste management, etc. This allowed the country, in September 2015, at the 21 Conference of the Parties in Paris, to put forward the ambitious GHG emissions reduction goals until year 2030, expressed in the Intended National Determined Contribution (INDC). Further, the Paris Agreement was ratified by the Law no. 78 of 04.05.2017[35].

In view of accomplishing the INDC, on 24 March 2017, the Low Emission Development Strategy of the Republic of Moldova until 2030 (LEDS) and the Action Plan for its implementation[36] was published and enforced. The document provides an integral vision regarding the change of the medium and long-term paradigm of economic development of the Republic of Moldova towards green economic development, based on a study of the low-carbon economic development constraints. In this respect, it will strengthen and guide the sectoral development approach that sets out the medium-term objectives and strategy for the country's climate change37. The approach of the LEDS is to expand the financial coverage to promote the appropriate GHG emissions mitigation policies in the national economy sectors, without compromising economic growth.

The overall goal of the LEDS is in line with the goal set forth in the Intended National Determined Contribution for the new climate Paris Agreement[38]. According to the latter, "the Republic of Moldova commits to achieve by the year 2030 the unconditional target of 64-67% reduction in GHG emissions compared to the baseline year (1990). Reduction by 64% corresponds to the scenario of energy system development that allows to cover internal consumption of electricity entirely from own generation sources, and 67% reduction scenario admits up to 30% electricity imports.

The commitment to reduce GHG emissions could be conditionally increased by up to 78% subject to a future global agreement, which would address issues important for the Republic of Moldova, as well as provide low-cost financial resources, transfer of technologies and multilateral technical cooperation, the access to all of these being proportionate to the global climate change challenges. "

The overall goal is supported by intermediate targets established for the years 2020 and 2025, including by sectors. The intermediate targets provide reduction in total national GHG emissions by at least 65% (by 2020) and 69% (by 2025) respectively, compared to 1990 levels. These targets may be increased provided there is more substantial financial support available through the international mitigation mechanisms planned to be developed and approved under the UNFCC. The targets for the year 2030 and the intermediate targets by each sector are presented in Table 3-1.

The LEDS will allow the RM to adjust the development path towards a low-carbon economy and to achieve green sustainable development, based on socio-economic and development priorities of the country.

[33] <http://data.worldbank.org/indicator/EN.ATM.CO2E.PC?view=map>
[34] <http://data.worldbank.org/indicator/EN.ATM.CO2E.PC>
[35] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=370323>
[36] Low Emission Development Strategy of the Republic of Moldova until year 2030 and Action Plan for its implementation. GD no.1470 of December 30 2016. Official Gazette, no. 85-91, 2017
[37] <http://www.clima.md/doc.php?l=ro&idc=236&id=3101>
[38] <www.clima.md>

Table 3-1: GHG emissions targets by sectors, %[39]

Sectors	Until year 2020		Until year 2025		Until year 2030	
	unconditional	conditional	unconditional	conditional	unconditional	conditional
Energy	78	82	76	82	71-74	82
Transport	49	56	41	48	30	40
Buildings	78	79	79	81	77	80
Industry	58	62	51	59	45	56
Agriculture	48	50	43	45	37	41
Land use, change in land use and forestry	12	18	43	54	62	76
Waste	23	26	46	51	38	47
TOTAL	65	71	69	76	64-67	78

[39] According to the LEDS

In order to achieve the overall goals and specific targets of the LEDS, the nationally appropriate mitigation activities (technologies and/or measures) (NAMA) have been identified for each sector concerned (energy, transport, buildings, industry, agriculture, forestry and waste) and prioritized based on the multi-criteria decision analysis method.

The actions are divided into three categories:

1. *Unilateral*: mitigation actions undertaken on the country's own account;
2. *Supported*: mitigation actions supported by financing, technology transfer and capacity building by the developed countries (included in Annex I to the UNFCC); and
3. *Credits*: mitigation actions with eventual generation of credits for the carbon market.

The LEDS, the Environmental Strategy for years 2014-2023, and the Action Plan for its implementation[40] are the normative documents of the Republic of Moldova, which expressly describe the state policy in the field of combating greenhouse gas emissions. In addition to these crucial documents, a number of other normative related to overcoming the climate change challenges have been approved, however, these are primarily focused on poverty reduction, economic growth, energy and food security etc., and environmental issues are only treated generally.

Among such documents are the National Development Strategy "Moldova 2020"[41], the Energy Strategy until year 2030[42], the Law on Energy Efficiency[43], the Law on Renewable Energy[44], the Law on Heat and Cogeneration Promotion[45], the National Strategy of Sustainable Development of Agribusiness of the Republic of Moldova (2008-2015)[46], the National Waste Management Strategy 2013-2027[47] and other.

Despite the fact that these documents do not directly look at overcoming the climate change challenges, meeting the objectives set forth in them will imminently entail significant reduction of specific GHG emissions.

The policies set forth in the documents referred to are to be implemented through programs and related action plans. In this respect, the National Energy Efficiency Program 2011-2020[48], the National Action Plan for Renewable Energy for the years 2013-2020[49], the Methodology for calculation, approval and application of tariffs for electricity produced from renewable energy sources and biofuel[50], the Conservation and Soil Fertility Enhancement Program for the 2011-2020[51], the State Program for Regeneration and Afforestation of Forest Lands for 2003-2020[52] and other have been already published.

3.2. Development of Climate Change Mitigation Policies

The Ministry of Agriculture, Regional Development and Environment, through its Directorate for Policy Analysis, Monitoring and Evaluation, coordinates the climate change related policies in the Republic of Moldova at official level.

Some policies with impact on climate change are under the responsibility of other ministries: the Ministry of Economy, Ministry of Transport and Road Infrastructure, Ministry of Agriculture and Food Industry through their Directorates for Policy Analysis, Monitoring and Evaluation.

Policies and programs specific to each of the ministries mentioned above are reviewed in this chapter.

3.3. Clean Development Mechanism of the Kyoto Protocol

The With Measures (WM) and With Additional Measures (WAM) scenarios presented in Chapter 4 indicate that the Republic of Moldova is in the process of meeting its commitments made at the 21st Conference of the Parties to the UNFCCC, which took place in 2015 in Paris. The commitments are set out in the document "Intended National Determined Contribution" (INDC) for the Paris Agreement, the objectives of which are specified in Chapter 3.1 above. According to the document, the RM acknowledges that the Clean Development Mechanism (CDM) of the Kyoto Protocol contributes and could play a significant role in achieving the goals.

In order to capitalize the GHG emissions reduction potential by using the CDM of the Kyoto Protocol and the Paris Agreement, the country set up the necessary institutions and the regulatory and informational framework. Thus, a Designated National Authority[53] under the Clean Development Mechanism of the Kyoto Protocol was set up within the Ministry of Agriculture, Regional Development and Environment to implement the provisions of the United Nations Framework Convention on Climate Change (UNFCCC) and the Mechanisms and Provisions of the Kyoto Protocol.

Two institutions are effectively involved in promotion of the Kyoto Protocol CDM projects:

- The Climate Change Office, which is working alongside the Ministry of Agriculture, Regional Development and Environment and is the knowledge hub in policy analysis and assessment of national GHG emissions[54];
- The Carbon Finance Office, which is working alongside the Ministry of Agriculture, Regional Development and Environment and currently supervises CDM projects in the RM.

[40] Environmental Strategy for years 2014-2023 and Action plan for its implementation. GD no. 301 of 24 April 2014. Official Gazette 2014, no. 104-109, art. 328.
[41] National Development Strategy "Moldova 2020". Law no. 166 of 11.07.2012. Official Gazette no. 245-247 / 791 of 30.11.2012.
[42] The Energy Strategy of the Republic of Moldova until 2030. Government Decision no. 102 of 05.02.2013. Official Gazette no.27-30 / 146 of 08.02.2013.
[43] The Law on Energy Efficiency, no. 142 of 02.07.2010. Official Gazette no.155-158 / 545 of 03.09.2010.
[44] The Law on Promoting the Use of Energy from Renewable Sources, no. 10 of 26.02.2016. Official Gazette no. 69-77 / 117 of 25.03.2016.
[45] The Law on Thermal Energy and Promotion of Cogeneration, no. 92 of 29.05.2014. Official Gazette no. 178-184 / 415 of 11.07.2014.
[46] National Strategy for Sustainable Development of the Agro-Industrial Complex of the Republic of Moldova (2008-2015). Government Decision no. 282 of 11.03.2008. Official Gazette of the Republic of Moldova no. 57-60 of 21.03.2008
[47] Waste Management Strategy for the Republic of Moldova for 2013-2027. Government Decision no. 248 of 10.04.2013. Official Gazette no. 82 of 12.04.2013.
[48] National Energy Efficiency Program 2011-2020, Government Decision no. 833 of 10.11.2011. Official Gazette no.197-202 / 914 of 18.11.2011.
[49] National Action Plan on Renewable Energy for the years 2013-2020, Government Decision no. 1073 of 27.12.2013, Official Gazette no. 4-8 / 1 of 10.01.2014.
[50] Methodology for calculation, approval and application of tariffs for electricity produced from renewable sources of energy and biofuel, ANRE Decision no. 321 of 22.01.2009. Official Gazette no.45-46 / 172 of 27.02.2009.
[51] Soil Conservation and Fertility Enhancement Program for the years 2011-2020. Government Decision no. 626 of 20 August 2011. 27. Official Gazette of the RM no. 139-145 of 26.08.2011
[52] The State Program for regeneration and afforestation of forest lands for the years 2003-2020. Government Decision no. 737 of 17.06.2003. Official Gazette of the RM no. 132 of 01.07.2003
[53] Government Decision no. 1574 of 26.12.2003 on the establishment of the National Commission for Implementation of the Provisions of the United Nations Framework Convention on Climate Change, and of the Kyoto Protocol mechanisms and provisions. Official Gazette no. 6-12, 01.01.2004.
[54] <www.clima.md>.

So far 10 CDM project proposals were registered, of which eight were registered at the CDM Executive Board. Detailed information about the projects concerned are provided in Table 7-4.

The carbon market does not exist in the Republic of Moldova and there is no designated budget specially created for carbon reduction. In order to assess the possibility of creating such market, a feasibility study was carried out[55]. The study has identified that implementation of the EU carbon trading scheme will be possible to be implement in the RM when the date of accession of the Republic of Moldova to the EU will be known[56].

3.4. Economic Instruments

Fees and other economic instruments can have a leading role in achieving the climate change control objectives. They can provide incentives for behavior that protects or enhances the environment and discourages actions with negative impact. Such economic tool as a "fee" contributes to the effective achievement of environmental objectives at low cost. Once the fees are reflected in the prices of goods and services, the latter signal towards structural changes in the economy, making it more sustainable. They can encourage innovation and the development of new technologies. The revenues received as a result of application of environmental fees can be used to reduce other taxes, thus contributing to lessening distortions in the economy.

From other countries experience, to be successfully applied a new fee has to meet certain requirements, before getting green light for the long run. In other words, it has to be well designed, to avoid accumulation of negative impacts in the future, or if they do occur, they should be minimal. Of course, the implications for international competitiveness also have to be taken into account. Where environmental fees meet these requirements, the Government should implement them.

Until now, few levers of this kind have been used in the RM specifically to reduce CO_2 emissions. Thus, the environmental pollution payments set by the Law on Environmental Pollution Payments[57], updated over time, including in 2017, are set in a way that do not arouse clear interest in GHG emissions reduction. Thus, pollution payment for emissions from stationary sources cover a list of pollutants that do not include GHG. While the tax for goods (the Law does not specify mobile sources separately) which cause environmental pollution when used (hydrocarbons, second-hand vehicles, fertilizers, etc., according to Annex 8[58] of the Law) is: a) 2% of the customs value of the imported goods and goods purchased from sellers on the territory of the Republic of Moldova which do not have fiscal relations with its budget system, and b) 2% of delivery value, excluding VAT, of the goods delivered by domestic producers.

The environmental pollution fee set for road transport[59] has been aimed at reducing carbon monoxide (CO), not carbon dioxide (CO_2) emissions. It was applied episodically.

[55] <http://www.undp.org/content/dam/moldova/docs/Publications/ETS_Feasibility_Study_UNDP.pdf>
[56] <http://www.mfa.gov.md/img/docs/Annex_6_to_Progress_Report.pdf>
[57] The Law on Environmental Pollution Payments, no.1540-XIII of 25.02.1998, Official Gazette of the RM no.54-55/378 din 18.06.1998.
[58] <http://lex.justice.md/UserFiles/File/2016/mo472-477md/an.8_1540.doc>
[59] Guidelines for calculation of environmental pollution payment following the instrumental ecological control of transport means as of 25.11.98. Official Gazette no.109-110/211 of 10.12.1998

However, it should be mentioned that lately the Government has increasingly provided incentives for promoting energy efficiency and renewable sources of energy. In the period 2012-2016, about 529.5 million lei were allocated from the state budget, along with donor support, for the Energy Efficiency Fund[60]. At the same time, aiming at marginalizing the import of second-hand vehicles, which are regarded as high rate emission sources, the Parliament of the Republic of Moldova has introduced a permissive age limit for the vehicles imported into the country[61].

During the period 2012-2015, being financially supported by the GEF, OECD, UNDP, the Government of Moldova was able to implement the project "Environmental Fiscal Reform" with a total budget of US$ 620.45 thousand[62], which aimed to strengthen the capacities of the Ministry of Agriculture, Regional Development and Environment to improve the existing legal and regulatory framework for the application of pollution fees, promotion of green technologies and improved subsidies in energy and agriculture, which have a positive effect on businesses and population at large.

The project has contributed to adjusting the management and operational practices of the National Ecologic Fund to the best Central and Western Europe standards to ensure sustainable development and implementation of environmental protection policies. At the same time, no fees aimed to motivate for GHG emissions reductions have been imposed so far, except for charges for halocarbons imposed by the Law on Environmental Pollution Payments.

3.5. Policies and Measures to Mitigate Climate Change at Sector Level

3.5.1. Energy Sector

The core document drawing up the policies in the energy sector is the Energy Strategy of the Republic of Moldova until 2030 that develops the sector policies and objectives set out in the National Development Strategy "Moldova 2020"[63].

The country's energy security is unsatisfactory, with the country's about 86.2%[64] dependency on imports of energy resources. In addition, energy efficiency is very low, with energy intensity surpassing the Western European one by about three times.

Under such circumstances, apparently the only way to deal with the accumulated problems is to make massive investment in the sector, technology transfer and up-to-date knowledge. In this sense, the most plausible way to overcome the accumulated problems is to promote the Western European ideals, further EU accession – an essential condition for opening up opportunities for economic growth and energy security. This fundamental concept is developed in the Moldova's Energy Strategy until the year 2030.

[60] <http://www.fee.md/media/files/Raport%20de%20activitate%20ianuarie-decembrie%202016.pdf>
[61] The Law on amending and supplementing selected legislation documents, no.154 of 21.07.2005, Official Gazette of the RM no.126-128/611 of 23.09.2005 (age limit for imported vehicles was increased from 7 to 10 years by the Law on amending and supplementing selected legislation documents, no.178 of 11.07.2012, Official Gazette of the RM no.190-192/644 of 14.09.2012; however, for vehicles older than 7 years higher fees are charged.)
[62] <http://www.green.gov.md/libview.php?l=ro&idc=36&id=83&t=/Cadrul-institutional/Reforma-fisca-la-de-mediu/Proiectul-PNUDGEF-Reforma-Fiscala-de-Mediu-2012-2015>
[63] National Development Strategy "Moldova 2020". The Law no. 166 of 11.07.2012. Official Gazette no. 245-247/791 of 30.11.2012.
[64] Energy Balance of the Republic of Moldova. Statistical Yearbook 2015. National Bureau of Statistics of the Republic of Moldova. Chisinau. – 2016. <http://www.statistica.md/public/files/publicatii_electronice/balan-ta_energetica/BE_2016_ro.pdf>

The Strategy has three main objectives for the period until 2030:

(1) security of energy supply;

(2) developing competitive markets and regional and European integration thereof;

(3) environmental sustainability and climate change control.

The specific objectives of the Republic of Moldova for the period 2013-2020 are as follows:

- Ensure the security of natural gas supply by diversifying supply sources and routes, types of carriers (conventional, unconventional gas, LNG) and by storage depots, at the same time strengthening the role of the RM as natural gas transit lane;
- Strengthening the role of the RM as electricity transit lane by construction of new interconnection lines, connecting to the ENTSO-E system and strengthening the internal electricity transmission network;
- Creating a strong platform for electricity and heat generation by retrofitting, ensuring heat supply through cost effective district heating systems and strong marketing;
- Improving energy efficiency and increasing capitalization and use of renewable energy;
- Ensuring legal, institutional and operational framework for a genuine competition, effective opening of the energy market, transparent and fair energy pricing, integration of Moldovan energy market into the EU's internal market;
- Ensuring a modern and competitive institutional framework for the energy sector development.

The Strategy sets out concrete measures and timelines for the accomplishment of these objectives:

a) *Diversification of natural gas routes and sources* - construction of the gas pipeline Iasi (Romania) - Ungheni (Moldova) - Chisinau until 2019[65] (capacity of 1.6 billion m³, now the RM consumes about 3 billion m³, including the left bank of the Dniester river); participation in the East-West natural gas mains construction projects; the RM has underground gas storages, but from an economic point of view, the issue is not yet sufficiently studied.

b) *Strengthening the transition role of electricity* - construction of 400 kV OEL: Suceava (Romania) - Balti (Moldova) and Straseni OEL (Moldova) - Iasi (Romania), or alternatives; construction of a new 300kV interconnection line Balti (Moldova) - HPP Novodnestrovsk (Ukraine); joining ENTSO-E towards 2019-2020, most likely through back-to-back stations costing € 210 million. Currently, the feasibility study for the construction of the first back-to-back station in the southern part of the Republic of Moldova is underway;

c) *Production of electric and thermal energy* - construction by year 2020 of 1050 MW new capacity, of which 650 MW by cogeneration in Chisinau, on natural gas; and 400 MW from renewables; rehabilitation of existing capacities; thermal energy: Termocom S.A. was restructured through acquisition by Termoelectrica S.A., the problem of debt for consumed natural gas to be solved by passing over the gas pipelines built from public money to the natural gas supplier;

d) *Increasing energy efficiency and the use of renewable energy sources* - by creating a modern regulatory framework; the targets set for the period until 2020 are the following:
   - reducing energy intensity by 20% by year 2020;
   - reducing losses in transmission and distribution networks by up to 11% in year 2020 (up to 13% by year 2015) for electricity, by 39% by year 2020 (by 20% by 2015) for natural gas and by 5% by 2020 (by 2% by 2015) for thermal power;
   - reducing GHG emissions (compared to 1990) by 25% by 2020;
   - reducing energy consumption in buildings by 20% by 2020;
   - the share of public buildings refurbished-10% by 2020;
   - In line with the EU's energy efficiency improvement targets, the National Energy Efficiency Program for 2011-2020[66] sets a 20% target of long term energy savings by 2020, which is 14 167 857 TJ and will contribute to the GHG emissions reduction by 761,498.7 tons of CO_2 equivalent;
   - ensuring a 10% share of annual production of electricity from renewable energy sources by 2020;
   - incentivizing the use of energy produced from renewable energy sources in relation to gross final domestic consumption. In this respect, it is planned to achieve a share of at least 17% of renewable energy in the gross final energy consumption in 2020[67];
   - achieving a share of at least 10% of energy from renewable energy sources in the final energy consumption in transports by year 2020.

e) *Actual competition, effective opening of the electricity and natural gas supply markets* – by developing appropriate regulations and increasing the number of electric power sources, including by establishing an electricity market operator[68]. The available interconnection capacity with neighboring countries should be allocated in a regulated manner. To this end, the Regulation on access to the electricity transmission networks for cross-border trade and managing congestion in the power system[69] has been approved. According to the provisions of the Law on Electricity, following the assessment of competition on the electricity market, including by applying the market concentration indicators established in the Electricity Market Rules, ANRE will establish deadlines for the gradual elimination of regulated prices for final consumers of electricity. Regarding the natural gas market, *de jure* it is liberalized since 1998, but final consumers are unable to choose the gas supplier due to a lack of alternative natural gas suppliers.

f) *Ensuring modern institutional framework* – by transposing and implementing the III Energy Package of the EC[70]:

[65] <http://www.expert-grup.org/ro/biblioteca/item/download/1494_b8aae7a181cf535fd861c0c56f7235bb>

[66] The National Energy Efficiency Program 2011-2020. GD no. 833 of 10.11.2011. Official Gazette no.197-202/914 of 18.11.2011.

[67] In conformity to the Law on Use of Energy from Renewable Sources no. 10 of 26.02.2016, Official Gazette, no. 69-77 of 2016. Date of entry into force-25.03.2017.

[68] In conformity with the provisions of the Law on Electricity no. 107 of 27 May 2016 2016, Official Gazette, no. 193-203.

[69] Regulation on access to electricity networks for cross-border trade and managing congestion in the power system. ANRE decision no. 353 of 27.12.2016, Official Gazette, no. 85-91 from 9.12.2016

[70] <http://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implemen-

market liberalization, tendering for energy supply and use of interconnection capacities, etc.

The specific objectives of the Republic of Moldova for the period 2020-2030 are:

- *Development of renewable energy sources use. Availability of long-term carbon capture and storage (CCS) technology.* If the carbon capture and storage technology at the coal-fired power plants does not become highly performing, the renewable sources will need to be developed at a more accelerated pace.
- *Improving energy efficiency.* The growing prices for CO_2 on the market will accelerate the implementation of energy efficiency measures.
- *Implementation of intelligent networks.* A specific regulatory framework will have to be developed and funds attracted to implement this idea.

Electricity from renewable sources

The policy framework governing the promotion of electricity from renewable sources is laid down in the Law on the Use of Energy from Renewable Sources[71]. If the objective to include renewable sources in meeting the electricity demand will be achieved, a decrease in GHG emissions by about 240 ktCO_2 by the year 2020 might be expected as a result of setting into operation of approx. 400 MW capacity, mainly of wind and photovoltaic origin.

Although the Renewable Energy Law no. 160 of 12.07.2007 (repealed on March 25, 2017) was approved in 2007, little progress has been made to effectively implement these sources, the main cause being the uncertainty created for investors to recover their investments in such power plants.

In conformity with the respective tariff calculation Methodology[72], the regulator is entitled to adjust the tariff calculated in conformity with the Methodology to the level of energy price, related to the best European and world practices. By April 2017, the installed power of biogas based power plants was 2.805 MW, of the wind based power plants - 2.33 MW and of the photovoltaic power plants - 1.8029 MW, the electricity being marketed at tariffs approved by ANRE for each separate producer.

A big contribution to construction of these sources was the financial support provided by the EBRD through the MoSEFF credit line[73], including up to 20% as a grant. Also, at private homes level there are private photovoltaic installations initiatives[74], however these are promoted with obvious precautions.

Recognizing the shortcomings of the legal framework for promotion of electricity production from the RES, a new law on the promotion of the use of energy from renewable sources[75] was passed in 2016, which establishes the framework for the implementation of Directive 2009/28 / EC of the European Parliament and of the Council of 23 April 2009 on the promotion and use of energy from renewable sources of energy and amending and repealing Directive 2001/77 / EC and Directive 2003 / 30 / EC. The law sets out the tendering method to determine the eligible producers who will have the right to sell electricity generated from renewable sources.

Tendering will be carried out in accordance with the Regulation on Tendering for granting the status of eligible producer to owners or intended owners of power plants which have a cumulative power that exceeds the capacity limit established by the Government, and regulated tariffs for some eligible producers, including the application of the net metering mechanism for electricity produced by final consumers at power plants producing electricity from renewable energy sources.

Aiming at successful accomplishment of commitments made towards implementation of RES and energy efficiency measures, the Government has created the Energy Efficiency Fund (EEF)[76], with a bigger part of its financial reserves intended as non-repayable financial support to RES investors. In between 2012-2016, a total number of 275 projects were implemented in energy efficiency and RES with a budget worth about 600 million lei[77]. The implemented projects already generate energy savings of approx. 9 ktoe/ year and reduce about 19 kt CO_2 equivalent of GHG emissions /year.

Since June 2014 the Moldova Social Investment Fund (MSIF) is assigned as an entity responsible for preparation, implementation, ensuring visibility and reporting on the *Program of Technical and Financial Assistance provided by the Government of Romania to pre-school institutions of the Republic of Moldova*[78], worth a total of €20 million. The beneficiaries of this Program are 797 pre-school institutions[79].

It should be mentioned that given the conditions of the RM with its significant dependence on electricity imports and which tends to cover the demand of electricity on the territory on the right bank of Dniester river from its own sources, the promotion of RES have to be carried out with great caution. Due to the lack of significant biomass reserves, it is expected that most of the RES development will be on the account of wind and solar energy sources. These sources, however, due to the intermittent electricity production, cannot be considered as sources meeting the pre-established power demand, for which reason the traditional sources of electricity are required to take over from the wind or photovoltaic sources when there is no wind and solar radiation, or they are not as the projected ones. From the perspective of taking over, the most reliable sources among the traditional ones, are gas turbines and combined cycle (CCPP).

Cogeneration power plants

The basic documents defining policies for the use and promotion of cogeneration power plants are the Law on Heat and Promotion of Cogeneration[80] and the Law on Energy Efficiency[81]. The Law on Heat and Promotion of Cogeneration regulates the principles and objectives of the State policy in the

tation/III_Package>.

[71] The Law on the Promotion of Use of Energy from Renewable Sources, no. 10 of the 26.02.2016. Official Gazette, 2016, no. 69-77, art 117. Date of entry into force-25.03.2017.

[72] Methodology for calculation, approving and application of tariffs for electricity produced from renewable energy sources and biofuels, no. 321 from 22.01.2009. Official Gazette No. 45-46/172 of 27.02.2009.

[73] <http://www.ebrd.com/pages/project/psd/2012/43067.shtml>.

[74] The private home in Criuleni with a total capacity of photovoltaic installations of 3kW

[75] The Law on the Promotion of Use of Energy from Renewable Sources, no.10 of 26.02.2016. Official Gazette no. 69-77/117 of 25.03.2016

[76] The Regulation on Organization and Operation of the Energy Efficiency Fund. Government Decision no. 401 of 12.06.12. Official Gazette no. 126-129 of 22.06.2012.

[77] <http://www.fee.md/media/files/Raport%20de%20activitate%20ianuarie-decembrie%202016.pdf>

[78] Implementation of the Program of Technical and Financial Assistance provided by the Government of Romania to pre-school institutions of the Republic of Moldova. Government decision no. 436 of 10.06.2014. Official Gazette no. 153-159/473 of 13.06.2014

[79] Program of Technical and Financial Assistance provided by the Government of Romania to pre-school institutions of the Republic of Moldova. http://fism.gov.md/ro/content/programul-de-asistenta-tehnica-si-financiara-acordata-de-guvernul-romaniei-pentru

[80] The Law on Heat and Promotion of Cogeneration, no. 92 of 29 May 2014, Official Gazette, 2016, no. 178-184, art. 415.

[81] The Law on energy Efficiency, no. 142 of 02.07.2010. Official Gazette no.155-158/545 of 03.09.2010.

field of district heating systems; management of the thermal power sector by the State; cogeneration, highly efficient cogeneration technologies and promotion thereof; calculation and approval of regulated tariffs for heat; licensing of activities in the thermal power sector; the rights and obligations of the thermal power entities, etc. The Law on Energy Efficiency provides for the promotion of energy efficiency and supporting the programmes for implementation of advanced power generation technologies, such as cogeneration.

More pragmatically this policy is developed in the Energy Efficiency Program for the years 2011-2020. According to the latter, the overall efficiency of cogeneration power plants with highly efficient combined cycle will not be less than 80%, and the electrical efficiency will reach 45-50% and these sources will be given priority in relation to imported electricity or electricity produced by thermal power plants.

It should be noted that in addition to high efficiency, in order to become economically advantageous, the CHPs should also have a load factor of at least 51% (4500 hours)[82].

Promotion of cogeneration is expected to be achieved by implementing the following basic measures:

- analysis of the national high-efficiency cogeneration potential, including highly efficient micro- cogeneration;
- establishing the necessary legal framework needed to promote the CHPs, including introduction of feed-in tariffs for the new CHPs.

Currently most of the power and heat produced centrally on the territory of the right bank of the Dniester river is produced by the three cogeneration heat plants: CHP-1, CHP-2 and CHP-Nord, which are deprecated since long time ago. Because of the low quality of services provided by heat suppliers in the past, consumers have preferred to switch to individual heating, thus decreasing the thermal load of the plants and entailing decrease in their overall annual efficiency. So, according to ANRE's[83] data, over the past five years, the efficiency of the CHP-1 varied between 64.7-82.6%, CHP -2 - 70.5-72.1%, CHP-Nord - 79.5-83.2%. A higher efficiency of 80% was shown by the S.E. Tirotex built in 2010 on the left side of the Dniester river. As regards the small capacity CHPs, only three (State University of Moldova, "Franzeluta" S.A. – yeast factory, and "Apa Canal Chisinau" S.A.). have been put into operation.

Because of the low performance of the district heating system in Chisinau, mainly because of the low quality of the services rendered and accumulated significant debts, the Government decided to restructure the district heating system, approving the GD no. 983 of 22.12.2011[84], the goal of which was setting up a reliable, competitive and transparent thermal power complex, ensuring supply of affordable, good quality heat for consumers, strengthening the country's energy security and increasing energy efficiency. So, in 2015, by the merger of the CHP1 and the CHP 2, and as a result of acquisition of the functional stock of "Termocom" S.A. under the bankruptcy procedure, a new undertaking was founded – "Termoelectrica" S.A. which became the main producer of electricity in cogeneration mode, producer and supplier of heat in Chisinau municipal area and its suburbs. It provides heating services to more than 7,000 buildings, including over 200 000 flats, covering circa 20 % of the total national consumption through the National energy system. Currently, given by the World Bank support, the project "SACET Efficiency Enhancement" is being implemented. The project aims at the modernization of district heating networks, by shifting from the Central Heating Points to modern Individual Heating Points with the goal to provide better quality and more efficient heating and hot water to final consumers.

Carbon emissions mitigation technologies

Carbon emissions mitigation technologies cover a series of generic options for reducing GHG emissions from burning fossil fuels, starting with the ones related to high efficiency conversion processes and ending with his capturing and storing of carbon. The Republic of Moldova does not have the capacity to develop its own such technologies, which is why the country plans to transfer them from other countries into its own economy. The structure of the power plants in Moldovan economy after year 2020 will depend on the outcome of the global problem of capturing and storing of carbon from coal-fired power plants. As specified in the Energy Strategy until 2030, if the CCS technologies do not show progress, the country will continue to focus on developing renewable sources of energy.

3.5.2. Transport sector

As a rule, reduction of GHG emissions in the transport sector shall be achieved through:

a) reducing the amount of carbon in fuels used for land vehicles;
b) increasing the efficiency of car fuel combustion;
c) encouraging use of environmentally friendly transport and promoting public transportation, as well as zero emissions transport modes (cycling, walking);
d) promotion of global emissions trading schemes;
e) improving infrastructure and charging for its use;
f) modal transport and improving freight transport.

Accomplishment of these objectives in the Republic of Moldova is provided in the policies formulated in several legal acts of the country.

Reducing the amount of carbon in fuels used for land vehicles

Reduction of the amount of carbon in the fuel used for land vehicles is expected to be achieved in two ways: (a) substitution of traditional fuels with compressed natural gas and liquefied petroleum gas, and (b) dilution of traditional fuels with biofuels.

The first option does not have any political support formulated respectively in the secondary legislation of the country. The driving force that pushes the car owners to take up this way is the much lower price for liquefied gas than for gasoline. For instance, in March 2017 the difference in prices was about 60-90%. When distances are long, this difference shortens the time of recovery of investments made in re-equipping the vehicle with liquefied gas systems, and encourages resorting to this method of increasing the operation efficiency of the road transport. As a result, in year 2015 of the total amount of fuel used by the land transport, 2.5% were liquefied petroleum gas, 28% gasoline and 69% diesel fuel[85].

[82] <http://www.carbontrust.com/media/19529/ctv044_introducing_combined_heat_and_power.pdf>.
[83] <www.anre.md>.
[84] Corporate, institutional and financial restructuring of the district heating system in Chisinau municipal area. Government Decision no. 983 of 22.12.2011. Official Gazette no. 233-236 of 27.12.2011.
[85] Energy Balance of the R. of Moldova for 2015. <http://www.statistica.md/pageview.php?l=ro&id-c=263&id=2197>.

The second option is promoted by the Law on Promoting Use of Energy from Renewable Energy Sources[86], the National Energy Efficiency Program for 2011-2020, etc.

The Law on Promotion of Use of Energy from Renewable Sources, published in 2016 and which is being implemented since 2017, provides for achieving a share of at least 10% for energy from renewable sources in the final consumption of energy in transport by 2020, calculated in conformity with the provisions of the Law.

The Energy Strategy until the year 2030 aims to achieve by year 2015 the goal of 5% of bio diesel mix in the total amount of diesel fuel sold, and 6% of bioethanol mix in the total amount of the gasoline sold. The corresponding goals for the year 2020 are 10% for both biodiesel and bioethanol.

The goal of using 10% of biofuel in transport sector is also specified in the Environment Strategy for 2014-2023[87].

So far, no biofuels were used in the RM. However, biofuels were produced for export, for example, in conformity with the Annual Report of the State Ecological Inspectorate[88], circa 260 tons of biodisel were produced and exported in 2009. It should be noted, that in 2013 the first bioethanol plant in the RM was put into operation[89].

Increasing the efficiency of the car fuel combustion

The RM does not have vehicles engineering industry. All types of needed cars are imported. In order to ensure a higher efficiency of cars, the Government had approved several decisions that limit the age of imported cars. So, by the Law no. 154 of 21.07.2005[90], the Parliament has approved the amendments to the Customs Code, that provide for prohibiting the import of cars and minibuses which have been in use for more than 7 years, and of trucks and buses which have been in use for more than 10 years. Measures taken lead to the completion of the fleet with the new car and taking out of old cars which do not meet the requirements of the national standards. In recent years the country's fleet is supplemented by new transport units, which are less polluting.

Due to amendments introduced by the Law no. 178 of 11.07.2012, starting from 2013 it is allowed to import vehicles which were in operation between 7 and 10 years. At the same time, in conformity with the Budget Law for 2013, import of cars older than seven years is subjected to higher excise duties, which increase by 5% for each year of operation. Thus, imports of eight years old cars, the rate of excise duties will increase by 5%, for 9 years old – by 10%, and for 10 years old – by 15%. Import of cars older than 10 years is not allowed in the RM, except for the end of 2016, when by amendments operated to the Customs Code and Fiscal Code registration of such vehicles became possible for a limited term of several months.

The results of the first few months of 2013 showed, that the introduction of excise duties does not contribute to braking the import of obsolete cars. Of the 4330 cars registered in Moldova, more than 80% are cars older than 5 years. Half of these are vehicles of 8 - 10 years of age[91]. About 80% of imported cars in 2014-2016 tend to be second hand vehicles. To the same end, it has been noted that during the period of 2006-2013 the share of vehicles up to 5 years old in the businesses inventory has increased from 7% in 2006, to 12% in the 2012. However, since 2013 their proportion begun to shrink, reaching the share of 8%[92] in 2015.

Encouraging use of environmentally friendly transport

The environmentally friendly transport encompass electric engine and hybrid vehicles. The latter combine an internal combustion engine with the technologies used in electric vehicles. Currently, there are just a few electric vehicles in the country, while hybrid vehicles are sold on the secondary market in increasing numbers. The amendments to the Fiscal Code[93] come to support these technologies by decreasing the excise rate by 50% for vehicles with hybrid engine, starting 01.01.2017.

The Low Emissions Development Strategy of the Republic of Moldova until 2030 specifies that mitigation actions which are to be supported by donors also include use of hybrid electric vehicles and hybrid electric vehicles with connection to the electrical network. The Technical Needs Assessment (TNA) survey in the RM[94] has showed that the use of hybrid electric vehicles potential by year 2020 can ensure a reduction by circa 25 thousand tons CO_2 annually, while use of electric vehicles – circa 97 thousand tons CO_2 annually. Among the development directions set forth in the Environmental Strategy for years 2014-2023 is the promotion of the European standards on vehicles, aiming at achieving compliance with the EU requirements and standards, as well as the development of a mechanism to stimulate and promote the national vehicles pool renewal.

The Transport Strategy of Chisinau municipal area[95] also fits into this context by having the improvement of the quality of public transportation as a goal, including achieving the level of 50% of vehicles compatible with €-3 or more superior standard by year 2020, and achieving a 30% emissions reduction.

Promotion of global emissions trading schemes

Air transport development strategy until 2012[96] stipulates that the planned renewal of the aircraft stock improves fuel consumption efficiency and reduces CO_2 emissions.

According to the Low Emissions Development Strategy until 2030[97], the air traffic sector, which contributes with circa 2% of global GHG emissions, is included in the European Union Emission Trading Scheme (EU ETS). This means that all air companies flying from and to the European Union must compensate for the flight emissions by buying emission permits (EUA – European Union Allowances) and/or certified emissions reductions (CER-Certified Emission Reductions).

The EU regulations for flights to and from the EU also apply for the RM, so the aviation sector is the first sector in the

[86] <http://lex.justice.md/md/363886/>

[87] <lex.justice.md/User Files/File/2014/mo104-109md/anexa_1_301.doc?

[88] <http://mediu.gov.md/images/documente/starea_mediului/rapoarte/nationale/p7_Anuarul_IES_2009.pdf>.

[89] <http://unimedia.info/stiri/prima-si-unica-fabrica-de-bioetanol-si-biogaz-din-rm-a-fost-data-in-exploatare-59689.html>, <http://zorgbiogas.ru/about/news/15778?lang=ru>.

[90] The Law on amending and completion of some legislative acts no. 154 of 21.07.2005, Official Gazette of RM No. 126-128/611 of 23.09.2005 (the age limit on imports of motor vehicles has been increased from 7 to 10 years by the Law on amending and completion of some legislative acts no. 178 of 11.07.2012, Official Gazette of RM No. 190-192/644 of 14.09.2012, but charges are higher for the import of motor vehicles older than seven years).

[91] <http://www.eco.md/index.php?option=com_content&view=article&id=8390:importul-mainilor-vechi-a-redus-piaa-primar-auto-cu-27&catid=104:auto&Itemid=475>.

[92] <http://www.statistica.md/pageview.php?l=ro&idc=350&id=3242>

[93] <http://lex.justice.md/md/368097/>

[94] <http://www.tech-action.org/Moldova.asp>.

[95] <http://www.chisinau.md/public/files/anul_2014/strategii/strategie_transport_chisinau_2014.pdf>

[96] Civil Aviation Development Strategy for 2007-2012. Government Decision no. 987 of 30.08.2007. Official Gazette no. 146-148 of 14.09.2007.

[97] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>

RM to be mandatory included in the EU emissions trading scheme, with the officially established ceiling of emission.

Improving the quality of roads

The poor state of roads has an adverse impact on the environment. Fuel consumption on the road which is in bad condition increases by up to 20%, generating additional emissions of harmful substances into the atmosphere. In addition, bad roads are an additional source of noise and vibration[98].

Because current and capital repairs were not made in the period 1998-2006, more than 80% of the roads length in Moldova exceeded their life time.

The effects of insufficient funding for maintenance and repairs of roads were amplified by systemic problems. Technical standards and norms used in the roads sector are outdated and do not meet current requirements, while the institutional structure of the road maintenance system is ineffective.

To overcome the problem of bad roads, the country's leadership, in the National Development Strategy of the Republic of Moldova 2020 "(2012), has described the roads as one of the four critical barriers (education, roads, access to finance and business environment) which hamper the harmonious and sustainable development of the country. Thus, according to the document, about 1,900 km of public roads shall be rehabilitated and 4,900 km of local roads shall be repaired by the year 2020. As a result, by the year 2020 the RM will have 38% of very good roads and 42% of good roads, with a corresponding impact on GHG emissions.

The action directions described in the Environmental Strategy for 2014-2023 also mention the adaptation of road construction conditions to climatic conditions, application of biodiversity protection requirements and environmental impact assessment in road construction.

In addition to the National Development Strategy "Moldova 2020", in the transport sector there are a number of other documents expressing the desire to solve the roads problem. Among these are: Transport and Logistics Strategy until year 2022[99], the Strategy for land transport infrastructure development for 2008-2017[100], the Law on Roads (1995), the Law on Rolling Stock (1996), etc. the Transport and Logistics Strategy sets the objective of bringing 35% of national roads in good condition (circa 1,100 of 3,336 km) by the year 2018, and 45% of public roads (circa 9,334 km of 4,200) by the year 2022.

The actions undertaken in this area in recent years have contributed to improving the state of the roads in the country. Contributions to the roads fund have increased up to 1,364 million lei in 2014[101] and 1524 million lei in 2015[102], including from the funding provided by external donors (EBRD, EIB, EC, MCC). If in 2006 as much as 7% of all national roads were in good condition, in 2016 their share increased to 58%[103].

Reducing emissions from air-conditioning systems in motor vehicles

In view of approximating the national legislation to the provisions of Directive 2006/40 / EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air conditioning systems in motor vehicles and amending Council Directive 70/156 / EEC, the Government Decision no. 1242 of 14.11.2016 on the Regulation on measures to reduce emissions from air conditioning systems of motor vehicles[104] has been approved. According to this regulation, "the air conditioning systems on any vehicle shall no longer be filled in with fluorinated GHG with a GWP_{100} greater than 150, except for re-filling the air conditioning systems containing such gases, which will have been installed on vehicles prior to 1 January 2021".

3.5.3. Buildings Sector

The share of the Buildings sector in achieving the energy efficiency and GHG emissions reduction goals is significant in the Republic of Moldova. GHG emissions attributed to buildings make up 21% of the total direct GHG emissions.

The main policies for reducing energy consumption in buildings are set out in the *National Energy Efficiency Program 2011-2020, the National Development Strategy "Moldova 2020"*[105], *Energy Strategy of the Republic of Moldova until 2030, the Law no.142 on Energy Efficiency* [106], *and the Law no.128 on Energy Performance of Buildings*[107]. The Law no. 142 establishes the legal framework needed for the implementation of the European Directive 2006/32 / EC of the European Parliament and of the Council of 5 April 2006 on energy efficiency of end-users and energy services, and repealing the Council Directive 93/76 / EEC, while the Law no. 128 shall transpose the Directive 2010/31 of 19 May 2010 of the European Parliament and the European Council of 19 May 2010 on the energy performance of buildings into the national legislation. According to the *National Development Strategy Moldova 2020* and to the *Energy Strategy until 2030*, the consumption of energy in buildings shall be reduced by 10% by year 2020, at the same time 10% of buildings will be renovated in the long run.

The Law on Energy Performance of Buildings sets minimum requirements for energy performance of buildings, use of renewable energy in buildings, energy inspections of buildings and heating systems to be used, the financial incentives to promote improvements in the energy performance of buildings, etc. The document also identifies the buildings where energy consumption tends to be almost zero:

a) after 30 June 2019 new public buildings should be buildings with almost zero energy consumption;
b) until 30 June 2021 all new buildings should be buildings with almost zero energy consumption.

The Law introduces buildings performance certificates for the new and existing buildings undergoing major renovations, and stipulates the certificates issuance procedure. The sale or renting of buildings will not be possible without the energy performance certificates.

98 National Development Strategy of the RM 2020 ". Law no. 166 of 11.07.2012. Official Gazette No. 245-247/791 of 30.11.2012.
99 <http://lex.justice.md/viewdoc.php?action=view&view=doc&id=350111&lang=1>
100 Land Transportation Infrastructure Strategy for 2008-2017.Government Decision no. 85 of 01.02.2008. 19. Official Gazette of the RM, no. 30-31 12.02.2008.
101 <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352091>
102 <http://mtid.gov.md/sites/default/files/files/program_235-full.pdf>
103 <http://www.realitatea.md/raport-despre-calitatea-drumurilor-din-moldova-in-total-418-km-de-drum-sunt-in-repara-ie-iar-58prc-din-totalul-traseelor-se-afla-intr-o-stare-mediocra_41611.html>
104 <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=367710>
105 The National Development Strategy for Moldova 2020 ". Law no. 166 of 11.07.2012. Official Gazette No. 245-247/791 of 30.11.2012
106 The Law on Energy Efficiency, no. 142 of 02.07.2010. Official Gazette No. 155-158/545 of 03.09.2010
107 The Law on Energy Performance of Buildings no. 128 of 11.07.2014. Official Gazette No. 297-309/609 of 10.10.2014

Starting with 30 September 2016, it is mandatory to provide energy performance certificates for public buildings and buildings frequently visited by the public with a total area of no less than 250 m^2.

The Ministry of Regional Development and Construction has drafted the *Roadmap to Energy Efficiency of Buildings* to ensure that the provisions of the Directive no. 2010/31 / EU of 19.05.2010 on the energy performance of buildings are transposed into the legislation of the Republic of Moldova[108]. The draft Roadmap sets out a series of steps required to implement the Law on Energy Performance of Buildings, including the actions specified in the National Energy Efficiency Action Plan for 2016-2018[109].

The Law on Ecodesign Requirements for Energy-Related Products[110] aims to transpose the Directive 2009/125 / EC of the European Parliament and of the Council of 21 October 2009 establishing the framework for eco-design requirements for energy-related products. The Law provides the legal framework for the eco-design requirements applicable to products with energy impact and sets the requirements for products with energy impact placed on the market and/or put into operation, thus contributing to sustainable development, energy efficiency and environmental protection, as well as to enhancing security of energy supply.

The Law on Energy Labeling[111] transposes Directive 2010/30 / EU of 19.05.2010 on the indication by labeling and standard product information of the consumption of energy and other resources of energy-related products. The Government of the Republic of Moldova adopted 8 regulations on requirements for the energy labeling of energy-related products[112]: household tumble driers, air conditioners, household ovens and kitchen stove hoods, electric lamps and lighting fixtures, household washing machines, household dishwashers, refrigerating appliances for domestic use, TV sets.

The Action Plan on Harmonization of Technical Regulations and National Standards in Construction with the European Legislation and Standards for 2014-2020[113] includes, among other things, transposition of EU legislation on construction into national legislation, development of roadmaps for the adoption and implementation of European standards in specific areas (Eurocodes – European standards for structure design, energy performance of buildings, health and safety on construction sites, etc.), collaboration with the National Institute for Standardization in view of replacing all existing GOST national standards with the identical or similar European standards, etc.

Other important relevant legislation are the Law on Housing Stock[114], the Law on Condominium[115], the Law on Authorization of Construction Works[116], the GD no. 111 of 12.02.2014 on approval of the Regulation on Technical Inventory and passporting the built dwelling blocks[117] .

In conformity with the National Action Plan on Energy Efficiency for 2016-2018[118], the final energy consumption reduction objective has been revised to reach 92.9 ktoe by 2016 and 167.2 ktoe – by 2020, with sector objectives also revised. Under this scheme, the sector objective to reduce final energy consumption until 2016 in the residential sector decreased from 40.8 to 40.1 ktoe (43.9% and 43.2%, respectively, of the total goal), while in the public sector it has increased from 11.7 to 27.8 ktoe (12.6% and 29.9%, respectively). The objective of reducing final energy consumption in the residential sector by 2020 became 72.2 ktoe (43.2% of the overall goal of 167.2 ktoe consumption reduction), while in the public sector it has reached to 50 ktoe (29.9%, respectively).

The results of policies and measures implementation in the construction sector are impressive. Until now the MoREEFF program has resulted in energy savings amounting to 15,481 MWh/years[119].

Among the future projects it is worth mentioning the project stipulated in the Loan Agreement for the "Energy Efficiency and Thermal Insulation of Public Buildings in the Municipality of Chisinau" project, signed with the EBRD and the EIB in 2016, with a total value of 25 million €, including EUR 5 million provided as a grant[120]. The first stage is thermal insulation of 22 public buildings in the capital city, with further insulation of 119 kindergartens, high schools and hospitals in the capital city[121].

Use of biomass for heating

The use of biomass for heating contributes to improving energy security and, at the same time to reduction of GHG emissions. A barrier that prevents the spread of this sources of energy is higher infrastructure costs relative to traditional sources. Consequently, the financial support for the promotion of this kind of projects should be adequately defined. The Law on Energy Efficiency[122] sets out the relevant policies which are more pragmatically formulated in the Energy Efficiency Program[123]. Implementation of policies is devised to be carried out through the EEF, mentioned above. At the same time, the most important support for the promotion of biomass heating projects registered to date is the international assistance, mainly provided by the EBRD, through the MoSEFF Project (1.15 million € already allocated to biomass-based heat plants ensuring GHG reduction of circa 2.3 ktCO_2[124]), and Energy and Biomass Project, financed by the EU (14.56 million €) and UNDP Moldova (0.56 million €), a total of 14.56 million € for the implementation period 2011-2014, the community

[108] The *Roadmap to Energy Efficiency of Buildings*. Draft. The Ministry of Regional Development and Construction. Chisinau 2012. <http://mdrc.gov.md/public/files/oldsite/files/5296_FOAIE_DE_PARCURS_EFICIENTA_ENERGETICA_CLADIRI_PROIECT.pdf>

[109] The draft GD on approving the National Action Plan on Energy Efficiency for 2016-2018. <http://particip.gov.md/proiectview.php?l=ro&idd=3254>

[110] Law No. 151 of 17.07.2014 *on Ecodesign Requirements for Energy-related Products*. Official Gazette No. 310-312/616 of 10.10.2014

[111] Law No. 44 on Energy Labelling, of 27.03.2014. Official Gazette No. 102/99-249 of 25.04.2014

[112] Approval of regulations on energy labelling requirements for the energy-related products. Government Decision No. 1003 of 10.12.2014. Official Gazette No. 386-396/1100 of 26.12.2014

[113] Harmonization of technical regulations and national standards in the field of construction with the European legislation and standards. Government Decision No. 933 of 12.11.2014. Official Gazette No. 340-343/996 of 14.11.2014

[114] Law No. 75 on Housing Stock of 30.04.2015. Official Gazette No. 131-138/249 of 29.05.2015

[115] Law No. 913 on Condominium of 30.03.2000. Official Gazette No. 130-132/915 of 19.10.2000

[116] Law No. 163 on Authorisation the execution of construction works of 9 July 2010. Official Gazette No. 155-158/549 from 03.09.2010

[117] Regulation on technical inventory and passporting of the existing dwelling stock. Government Decision No. 111 of 12.02.2014. Official Gazette No. 42/127 of 17.02.2014

[118] <https://monitorul.fisc.md/editorial/guvernul-a-aprobat-planul-national-de-actiuni-in-domeniul-eficientei-energetice-pentru-anii-2016-2018.html>

[119] MOREEFF Statistics. <http://moreeff.info/statistica-moreeff/>

[120] Chisinau Municipality has signed a Loan Agreement with EBRD and EIB for thermal insulation of buildings. <http://www.moldpres.md/news/2016/12/06/16009720>

[121] Project on thermal insulation of buildings in the capital city and the loan agreement with EBRD and EIB, voted and debated at the CMC meeting <http://bani.md/proiectul-privind-izolarea-termica-a-cladirilor-din-capitala-si-contractul-de-imprumut-cu-berd-si-bei-votat-si-dezbatut-la-sedinta-cmc-video---89033.html>

[122] The Law on Energy Efficiency, no. 142 of 02.07.2010. Official Gazette No. 155-158/545 of 03.09.2010.

[123] National Energy Efficiency Program 2011-2020, Government Decision No. 833 of10.11.2011. Official Gazette No. 197-202/914 of 18.11.2011.

[124] <http://www.moseff.org/index.php?id=101#c1249>.

contribution of at least 15% of the project investment value. As a result of the project implementation during 2011-2014, 144 public institutions were provided with biomass-based heating systems with total capacity of 29.6 MW, which ensure reductions of about 25 kt CO_2 per year[125].

Aiming at strengthening the bioenergy sector, the European Union has allocated additional funds to finance the expansion of the project, worth 9.41 million €. In January 2015, the project proceeded to the second implementation phase, with the mandate of activity until November 2017. By April 2017 biomass-based heating systems of 11.2 MW with solar panels (793.2 m^2) were installed in 102 public institutions.[126]

The biomass use potential at the national level is about 21 042 TJ[127] per year, which is 22% of the total energy resources needed for the country.

3.5.4. Industrial Sector

Over the recent period of time a number of policies pertaining to GHG emissions reduction in the industrial sector have been approved and are underway. The most relevant of these are the following:

- The Law on the Accession of the Republic of Moldova to the Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (2006)[128] and the Law on approval of the Regulation on the trade regime and regulation of the use of halogenated hydrocarbons depleting the ozone layer (2007)[129], by which the ozone layer depleting substances are prohibited, or have a strict record keeping and management regime in the Republic of Moldova. In September 2009, the European Bank for Reconstruction and Development (EBRD) launched the Energy Efficiency Finance Financing Line in Moldova (MoSEFF Project), with effective GHG reduction impact of about 57,511 tons[130], which continued in 2016 as well.
- The National Program for Energy Efficiency for 2011-2020, besides the objectives set for the country as a whole, also formulates targets for the industrial sector. Thus, aiming at reducing energy demand, and capitalizing on the energy saving potential through the use of equipment, machinery and advanced technologies, the following measures were designed:
    a. development and proposing of voluntary agreements for accomplishing energy savings in industry. According to estimates, the long-term agreements allow 10 to 20% of energy savings. Voluntary agreements shall be transparent and shall contain, where appropriate, quantified, monitoring and reporting objectives;
    b. developing an energy efficiency program for the industrial sector;
    c. considering the possibility of applying white certificates schemes;
    d. monitoring of energy consumption in the sector through the development by the Energy Efficiency Agency of an energy efficiency questionnaires and getting the enterprises with high consumption of energy to fill them in by the end of each year;
    e. information and training the industry sector about energy management and training, as appropriate, of energy managers;
    f. avoiding the use of fluorinated gases where possible and cost efficient. During 2010-2016 the Republic of Moldova has imported 516,743 tons refrigerants with a global warming potential (GWP) of 1,024,955.7 tons CO_2 equivalent.
- National Energy Efficiency Action Plan, which is developed for three years and is intended for the implementation of art. 17 of Law no. 142 of 2 July 2010 on energy efficiency and the Government Decision no. 833 of 10 November 2011 "On the National Energy Efficiency Programme for 2011-2020". The sole purpose of this document is to improve energy use and to reduce GHG emissions. The first NEEAP for 2013-2015[131] has been finalized, and currently the NEEAP for 2016-2018[132] is being implemented. The NEEAP 2016-2018 provides for the 15% or 72 ktoe of energy savings in industry by 2020.
- The Industrial Development Strategy until 2015[133], which establishes the basic principles, objectives and priorities of the sector development, as well as the main mechanisms and instruments for its implementation, which ensure the efficiency and competitiveness of the industrial sector.
- The Cooperation Agreement between the Republic of Moldova and the United States Agency for International Development and Government of Sweden[134], through the Competitiveness Enhancement USAID project, provides for allocation of US$22 mil for the core industrial sectors of the RM in the next four years (2016-2020), supporting 450 enterprises. As a result, jobs will be created, which will help to reduce poverty and migration. Moreover, 18 thousand Moldovans will improve professional skills through the industrial centers of excellence and innovative hubs.
- The Law on Industrial Parks[135], based on which nine industrial parks are currently in place and operational. The details to this chapter are provided in Chapter 6.2.1.
- The Law on Environmental Pollution payments[136]. According to the amendments made to the Law in 2016 and 2017, fluorines replacing the ozone depleting substances are not included in the list of goods which, during use, cause environmental pollution. Consequently, they are not subject to taxation and therefore are motivated to be used.

[125] <http://old.biomasa.md/img/docs/MEBP_Proiecte_de_incalzire_a_institutiilor_publice_01.12.2014_RO.pdf>
[126] <http://biomasa.md/wp-content/uploads/2016/02/MEBP-II_Lista-proiectelor-aprobate-pentru-investitii_10.04.2017_ENG.pdf>
[127] <http://www.biomasa.aee.md/img/docs/biomass-heating-systems-ro.pdf>.
[128] Law on the accession of the REPUBLIC OF MOLDOVA to the amendment to the Montreal Protocol on substances destroying the ozone layer image, no. 119-XVI dated 18.05.2006. Official Gazette No. 87-90/391 from 09.06.2006.
[129] Law approving the trade regime and the use of halogenated hydrocarbons destroy ozone layer, no. 852-XV of 14.02.2002. Official Gazette of RM No. 54-55/383 from 18.04.2002 (amended in 2007).
[130] <www.moseff.org>
[131] PNAEE 2013-2015. <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=346722>
[132] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369635>
[133] The industry's development strategy for the period until the year 2015. Government Decree No. 1149 from 05.10.2006. Official Gazette of RM No. 164-167 from 20.10.2006
[134] Cooperation Agreement between the R. of Moldova, USAID and the Government of Sweden - <https://www.radionoroc.md/stiri/main/2955?page=1>
[135] The Law No. 182 of 15.07.2010 on Industrial Parks and amended by the Law No. 276 of 15.11.2013. Official Gazette No. 155-158 of 03.09.2010.
[136] <http://lex.justice.md/viewdoc.php?action=view&view=doc&id=311615&lang=1>

It should be noted, that in the industrial sector the environment related issues are reflected only episodically and as a rule, very generally, in a number of laws, such as the Law on Entrepreneurship and Companies (1992), the Law on Standardization (1995), the Law on Certification (1999), the Law on Licensing of certain types of activity (2001), the Law on Industrial Safety of Hazardous Industrial Objects (2000) the Law on Technical Regulation (2006), etc.

At the same time, in pragmatic format the industry's contribution to reduction of GHG emissions is reflected in the Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation, published in March 2017. According to the Strategy, in order to fulfill the Intended National Determined Contribution of the R. of Moldova, the level of GHG emissions in industry by the year 2030 shall be by at least 45% lower compared to the year 1990 under the unconditional scenario, and by 56% under the conditional scenario.

3.5.5. Agricultural Sector

Greenhouse gas emissions from the agricultural sector are basically generated by three large sources: enteric fermentation, waste management, and agricultural soils. In 2013 the agricultural sector was the major source of CH_4 and N_2O emissions, accounting for circa 22.1%, and respectively 91.4% of total national emissions. CH_4 emissions are generated by enteric fermentation and from animal manure, while N_2O emissions– by agricultural soils and to a less extent from animal manure.

The source of CH_4 emissions from the source category 3A1 "Enteric fermentation" is the stomach of ruminant cattle, where methane gas is generated, and which is subsequently released into the atmosphere. The source category 3B "Manure management" generates both, methane and nitrous oxide. As a rule, poorly aerated manure management systems generate large amounts of CH_4 and smaller amounts of N_2O, while well-ventilated systems generate fewer CH_4 emissions and more N_2O emissions.

Direct sources of N_2O emissions from agricultural soils are those resulting from the nitrogen incorporated into the soil with chemical nitrogenous and organic fertilizers, from the incorporation into the soil of the nitrogen contained in the urine and animal manure excreted by domestic animals during grazing, from incorporation of agricultural residues into the soil, and from nitrogen mineralization due to soil carbon losses as a result of changes in the use of agricultural land and soil management practices.

Enteric Fermentation

The Republic of Moldova does not have approved policies geared towards diminishing the environmental impact of enteric fermentation. The main purpose of cattle breeding activities has been and still is meeting the demand of population for foods of animal origin. This goal is being achieved by implementing programs and strategies aimed at improving the genetic pool of farm animals and poultry, contributing to increasing productivity and decreasing the specific amount of fodder per production unit. In parallel with these positive effects in animal productivity, the specific GHG emissions (per production unit) decrease, although the overall amount of emissions will inevitably grow upon revitalization of the animal husbandry sector, increase in livestock and poultry numbers.

The basic animal husbandry policies with an indirect impact on the implementation of the commitments of the RM under the UNFCC reflected in several laws and strategies, include the Law on Veterinary Activity (1993), the Law on Selection and Reproduction in Animal Husbandry (1995), the Law on Animal Husbandry (1999), the Law on Food (2004), the National Strategy for Sustainable Development of Agribusiness of the RM for 2008-2015 (2008)[137].

Based on these policy documents concrete action have been taken towards the implementation of the respective policies, including:

- Orders of the Ministry of Agriculture and Food Industry regarding some measures on improving the cattle genetic pool by means of artificial insemination, no. 101 of 21.05.2008, no. 46 of 24.02.2009, no. 58 of 02.04.2010, and no. 98 of 26.05.2011[138],
- The state enterprise "Moldsuinhibrid" for research in swine selection and cross-breeding was created[139],
- The cattle farming enhancement program for years 2014-2020 was approved (Order no. 146 of the MAFI of 26.06.2014),
- The sheep and goat farming enhancement program for the years 2014-2020 was approved (Order No. 146 of the MAFI of 26.06.2014).

Implementation of such programmes contribute positively to recovery of the animal husbandry sector, increase in productivity and increase of livestock numbers and, ultimately – to the increase in global production of foods of animal origin. Along with these positive trends the amount of GHG emissions will also increase, however the specific emissions (related to production unit) will decrease.

Manure Management

The regulatory framework of the Republic of Moldova does not include policies specifically aimed at manure management. At the same time, the country's policies geared toward boosting the use of renewable sources of energy, as well as soil conservation technologies, contribute to manure becoming increasingly valuable, whether they are used for the production of biogas as fuel to produce electricity, or used as organic fertilizer on agricultural lands, being obtained as a result of:

- depositing manure on specially built and properly equipped platforms;
- processing of manure by composting;
- manure processing for biogas production.

[137] The National Strategy on Sustainable Development of Agribusiness of the Republic of Moldova (2008-2015). Government Decision No. 282 of 11.03.2008. 54. Official Gazette of RM No. 57-60 of 21.03.2008

[138] <http://lex.justice.md/?search=true>.

[139] Government Decision No. 1095 from 08.09.2003 on research in swine selection and cross-breeding. Official Gazette No. 200-203/1149 on 19.09.03.

Thus, in Colonita community, a 83 kW power plant, operating on manure collected from nearby settlements was put into operation in 2006. Since 2011, the energy produced is fed into the power grid and is priced according to the tariff approved by ANRE. Similar plants that use manure to produce biogas, but with a lower capacity, also operate in the Farladeni village in Hancesti district and Zabriceni village, Edineti district[140].

Agricultural Soils

Moldova has particularly valuable soils, which now are inappropriately used. The soils can yield higher crop productivity than they currently do. The economic and energy crisis, implementation of reforms in agriculture, along with the increased number of small land owners who do not have appropriate equipment and specialized knowledge, resulted in increasingly intense soils degradation processes. The main causes of soil degradation are: (1) use of inappropriate soil cultivation technologies; (2) allocation of land without taking into account the soil conservation and fertility maintaining needs; (3) failure in crop rotation; (4) lack of funding at all levels: national, local and individual owner; (5) limited access to information about the efficient use of soils; (6) unauthorized deforestation on agricultural lands; (7) lack of appropriate forest buffer zones. Soil degradation is estimated at 3.1 billion lei annual losses, including losses due to soil erosion, landslides and ravines, and losses in agricultural production.

Main factors of soils degradation and land desertification in the Republic of Moldova are: (1) the misbalance between natural and anthropogenic ecosystems determined by the high share of arable lands; (2) soil erosion, including deflation; (3) dehumification and chemical degradation; (4) active landslides; (5) soil salinization; (6) damage of the structure and physical degrading; (7) wetlands degradation / destruction; (8) excessive grazing, etc.[141]

Long-term preservation of the soil quality by increasing the content of organic matter in soil as humus is the only way to reduce GHG emissions from agricultural land.

The above goal has been stipulated in a number of strategies and agribusiness sustainable development programs[142].

Unfortunately, little progress has been made. As a result, over the past 25 years agriculture has been mainly driven by exploitation on soils natural fertility (the humus content available in soils). As a result, any increase in harvest, caused by the climate factor, not followed by compensation of organic matter losses in soil, has led to the increase in GHG emissions into the atmosphere. Thus, the increasingly intense dehumidification processes resulting from subsistence farming has led to a decrease in carbon accumulated in the soil, an increase in CO_2 emissions and a decrease in the quality and fertility of agricultural soils.

To overcome the situation, in 2011 the Ministry of Agriculture and Food Industry developed and the Moldovan Government approved the Program of Soil Fertility Preservation and Enhancement for the period 2011-2020[143]. In particular, it provides for halting the degradation of the active forms of soil cover degradation the area of about 877 thousand hectares of arable land (about 50% of the surface of arable lands) and undertaking actions for soil fertility conservation and enhancement on the area of 1.7 million ha by 2020. Unfortunately, this programme's financial coverage is insufficient (circa 18 million lei annually) and cannot ensure radical changes of the existing situation. Some improvements may be expected from the actions undertaken by agricultural economic operators through the implementation of environmentally friendly and least costly farming practices, such as crop rotation, use of fertilizers, conservative tillage system, etc. At present unconventional ploughing is used on about 70% of the arable lands, while new technologies such as "no-till" and "mini-till" are used on about 2.4 % of arable lands only. Crop residues from the previous harvest are incorporated into soil on circa 30% of the arable lands only. Crop are not rotated regularly. The quantity of chemical fertilizers used in agriculture is low, on average about 20 kg of active substance/ha; practically no organic fertilizers are applied to soil – on average about 10 kg/ha (mainly used in greenhouses and when planting orchards).

It should be mentioned that other policy documents aimed at meeting the goals of enhancing soils fertility were also approved, including:

- the National Complex Soil Fertility Enhancement Program for 2001-2020[144].
- The National Agricultural and Rural Development Strategy for 2014-2020.
- The Environment Strategy for 2014-2023 and Action Plan for its implementation[145].
- The Climate Change Adaptation Strategy of the Republic of Moldova until year 2020 and Action Plan for its implementation[146].

A number of draft policies are planned to be approved in 2017, which will have a positive impact on the situation in agriculture, rural areas and GHG emissions reduction in agricultural sector. Among these is the draft of Government Decision regarding the method for distributing the means of the National Agriculture and Rural Development Fund, which has grown over the past 5 years from 280 million lei in 2010 to 900 million lei in 2016. The grants provided from the Fund will significantly contribute to improving fertilization of agricultural soils.

Improvement of the situation related to enhancing the soil quality status requires the following urgent actions:

a) proper anti-erosion and hydrological planning of agricultural lands, taking into consideration the suitability of lands for various use;

b) implementation of conservation soil cultivation systems;

c) creating a mandatory system of organic fertilization of soils by using green fertilizers and organizing the pro-

[140] <http://www.publika.md/energia-alternativa-tot-mai-populara-o-instalatie-cu-biogaz-functioneaza-la-o-manastire-din-edinet_2234451.html>

[141] <http://www.undp.md/media/tender_supportdoc/2013/645/Strategia%20Nationala%20a%20Programului%20de%20Granturi%20 Mici.pdf>.

[142] Government Decision No. 282 of 11.03.2008 on approving the national strategy on sustainable development of agribusiness of the Republic of Moldova (2008-2015). Official Gazette No. 57-60 of 21.03.2008. Government Decision No. 1199 on approving the development strategy of agri-food sector for 2006-2015. Official Gazette No. 170-173 of 03.11.2006. Government Decision No. 636 of 26.05.2003 on approving the use of new lands and increasing soil fertility (part I and part II). Official Gazette No. 99-103 of 06.06.2003.

[143] Government Decision no. 626 of 20.08.2011 on approving the Program of soil fertility preservation and enhancement for the period 2011-2020. Official Gazette no. 139-145 of 26.08.2011.

[144] Government Decision No. 626 of 20.08.2011 on approving the Soils Conservation and Fertility Enhancement Program for 2011-2020. Official Gazette No. 139-145 of 26.08.2011

[145] The Environmental Strategy for 2014-2023 and Action Plan for its implementation. Government Decision no.301 din 24.04.2014. Official Gazette no. 104-109 as of 06.05.2014

[146] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=355945>

cess of manure collection from individual households for composting, and its subsequent implementation at community level;

d) introducing crop rotation, decreasing the share of hoeing crops;

e) harmless chemical fertilization (required minimum) of agricultural crops, etc.

3.5.6. Forestry Sector

It is well known that forests are a key element for the maintaining of eco-systemic equilibrium, protection of land and water resources, improving the national landscape, the appearance and microclimate of settlements. The forests had always been having this role, and when human activity has contributed to climate change, the importance of forests has increased even further - they became a crucial element of carbon removal and regularization of hydric and thermal regime of the landscape.

According to historical records, only two centuries ago more than 30% of the territory on which our country is set now, was occupied by forests. Now, the share of forests is much smaller and accounts for about 12% of the country's territory. While in Europe forests cover nearly 45% of the surface of the continent[147].

Wishing to change the current situation, the country's authorities have set the target to expand the forests area up to 15%[148] by 2020, at the same time enhancing the condition of existing forests. Similar tasks are stipulated in the Environmental Strategy[149], where among the specific objectives are the expansion of forests to up to 15% of the country's territory, of natural areas protected by the state up to 8.1% and ensuring efficient and sustainable management of natural ecosystems. In order to achieve this objective it is planned to create and restore riparian protection stripes and watersheds on the area of 30 thousand ha, forests on degraded lands, green spaces - on the area of 150 thousand hectares. These activities are planned for the period until 2023. To this end, over the last decade a number of concrete policies aimed at accomplishing by the year 2020 of this objective, equivalent to planting of about 130 thousand hectares of forest vegetation, have been approved. Among these it is the National Plan for expanding the areas with forest vegetation for 2014-2018[150], which provide for afforestation of degraded lands, of watersheds and water basins protection stripes, as well as farmlands protection forest belts on the area of 13 041 ha.

In addition to increasing the woodland surface, the forests in the RM require multiple activities aimed at improving the quality thereof. Thus, according to the results of various reports/studies the major malfunctions that characterize the current condition of the forests in the Republic of Moldova, are:

- worsening of the health and vitality condition of forests;
- the spread of adventive and invasive species;
- about 60% of forest vegetation originates from the 2-4 generation of vegetative offshoots (in sessile oak it is approximately 90%), with a much reduced resistance to biotic and abiotic harmful factors;
- approximately 40% of arboretums do not comply with the standing conditions.

This situation also affects the productivity of oak species, 43% of which have high productivity and 57% - lower productivity.

In order to improve the situation in the national forest sector it is necessary to implement the following actions:

- preparation of a comprehensive study on the current state of forests and forecasting its future evolution, including under the climate change hypothesis;
- development and implementation of a national programme for the improvement of the status of degraded forests and forest biodiversity conservation;
- the completion of the process of compiling the seed database;
- gradual reconstruction/replacement of arboretums non-compliant with standing conditions;
- gradual conversion of oak species arboretums from grove to forest mode.

The regeneration of the existing forests and the expansion of areas covered with forest vegetation is provided for in a number of normative acts, updated on numerous occasions, including the Law no. 1515-XII of 16.06.1993 on Environmental Protection (1993), the Forestry Code (Parliament Decision no. 887-XII of 26.06.1996), the Law for Improvement of Degraded Lands by Afforestation (Parliament Decision no. 1041-XIV of 15.06.2000), the Strategy for the Sustainable Development of the Forestry Sector (Parliament Decision no. 350-XV of 12.07.2001), the National Strategy and Action Plan for Biological Diversity Conservation (Parliament Decision no. 112-XV of 27.04.2001) , Government Decision no. 636 of 26.05.2003 on approval of the Program for Land Reclamation and Soil Fertility Enhancement (2003), Government Decision no. 737 of 17.06.2003 regarding the approval of the State Program of regeneration and afforestation of woodlands for the years 2003-2020, Government Decision no. 739 of 17.06.2003 on the implementation of the Strategy for Sustainable Development of the National Forest Sector, the Environmental Strategy for the years 2014-2023[151] , Government Decision no.101 of 10.02.2014 on approval of the National Plan for expansion of surfaces covered with forest vegetation; numerous international agreements to which the Republic of Moldova is a party (the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, the Convention on Combating Desertification, etc.) and other laws and decisions of the Government of the Republic of Moldova that directly or indirectly refer to the respective sector.

Regeneration and Afforestation of the Forest Fund Lands

The State Program for regeneration and afforestation of forest lands is planned for 2003-2020[152], covering relevant policies which are being implemented. The programme calls for the

[147] <http://www.ecomagazin.ro/republica-moldova-codasa-la-capitolul-paduri-vezi-care-este-cea-mai-impadurita-tara-din-€pa/>.
[148] The national Strategy and Action Plan on Biodiversity Conservation. The Law no. 112-XV of 27.04.2001. Official Gazette no.90-91/700 of 02.08.2001.
[149] The Environmental Strategy for 2014-2023 and Action Plan for its implementation. Government Decision no. 301 din 24.04.2014. Official Gazette of the RM no. 104-109 of 06.05.2014.
[150] Government Decision no.101 of 10.02.2014 regarding the approval of the National Plan to expand the area of land with forest vegetation for the years 2014-2018. Official Gazette No. 35-41 from 14.02.2014.
[151] Government decision No. 301 from 24.04.2014 regarding the approval of the Environmental Strategy for the years 2014-2023 and action plan for its implementation. Official Gazette No. 104-109 from 06.05.2014.
[152] Government decision No. 737 from 17.06.2003 approving the State Program for regeneration and afforestation of the forestlands for the years 2003-2020, Official Gazette No. 132-133 of 01.07.2003.

regeneration and afforestation of the forest fund areas of 95.1 thousand hectares, and accomplishing this amount of work require 588.1 million lei or 32.2 million spending annually. For the period 2003-2020 forests regeneration works have been planned to be carried out on the total area of 95.5 thousand ha, as follows: planting of homogeneous stands – 24.6 thousand ha, helping natural regeneration – 39 thousand ha, and natural regeneration – 31.4 thousand ha.

During the period 2003-2016, however, planned works were not accomplished to their full extent. So, the forest regeneration works have been effectively carried out on as much as 55.3 thousand ha[153] (58.1%), including planting of homogeneous stands – on 14.6 thousand ha (59.3%), helping natural regeneration along with natural regeneration - on 40.7 thousand ha (57.8%).

Of the total area of 55.3 thousand ha, where forest regeneration works have been carried out, 14.6 thousand hectares (27.9%) were planted with homogeneous stands, and on 40.7 thousand ha regeneration and helping natural regeneration works have been carried out. The reason of non-accomplishment of objectives is failure to use the possibilities in cutting the main products, including those affected by natural calamities.

As a result, it has been found that the State Programme of regeneration and afforestation of forest fund lands for 2003-2020 level has been fulfilled at only 58.1%. By keeping the same pace of work, the programme is unlikely to be fulfilled. The main reason of such state of things is lack of adequate financial coverage.

Land Use and Soil Fertility Enhancement

The Land Use and Soils Fertility Enhancement Program[154] was designed for the period 2002-2010.

Analysis of work carried out under this programme showed that the Program's objectives were not effectively fulfilled, the main reason being lack of adequate financing of the planned actions.

Of the total area of 133.1 thousand hectares of land intended for afforestation, forest plantations have been planted on 58.3 hectares (43%), field protection stripes have been planted on 75 hectares (0.6%), watershed protection forest belts have been planted on 168 hectares (0.1%), 57.9 thousand hectares of degraded lands (80%) have been afforested, while anti-erosion strips were not created at all.

Kyoto Protocol Clean Development Mechanism Projects

Two CDM projects dedicated to regeneration, afforestation, and soil conservation have been proposed and are running:

- The World Bank supported Project Soils Conservation in Moldova, launched in 2002. It provides for rehabilitation and conservation of soils through afforestation of 20.3 thousand hectares of land in the process of degradation, with the major aim of contributing to implementation of UNFCC provisions and Kyoto Protocol mechanisms. The owners of the land intended for afforestation are 383 mayoralties and 23 forestry undertakings in all territorial-administrative units of the country, with the exception of Transnistria. The main activity of the project - planting of homogeneous stands, is practically completed. In addition to the harvested forest products, the net reduction of CO_2 emissions in the first 20 years will be 3.6 million tons, of which 1.9 million tons in 2004-2017 have already been contracted from the World Bank funds. For the period 2004-2015, about 1.7 million tons of CO_2 emission reductions were reported, of which 851911 tons were certified in 2012.
- The World Bank supported Project Development of Community Forestry Sector in Moldova, effectively launched in 2006, with the purpose to create new communal forests on an area of 8.5 thousand ha, by afforestation of eroded or non-productive lands, carbon removal, enhancing regional and local forestry resources, additional provision of wood and developing a basis for sustainable local/ regional development. The planned lending period under the project is 30 years (2006-2035). Total CO_2 removal over the entire lending period is 1.3 million tons, of which 600 thousand tons of CO_2 have already been contracted from the World Bank Funds. Almost 0.5 million tons of CO_2 have been reported for 2006-2016, of which over 300 thousand tons CO_2 were certified in 2013.

Use of Wood Mass

In addition to removing carbon during photosynthesis, forests are an additional source of GHG emission reductions as a result of the use of wood harvested for energy purposes during forest tending, and substituting the fossil fuels. To make this process more efficient, the Government Decision no. 1184[155] of 22.12.2010 and no. 890 of 28.12.2015[156] have been passed, which allowed harvesting of 1,940 thousand m^3 wood in 2011-2015, and 1,871.5 thousand m^3 in 2016-2020, during the cuttings of the main wood products in the forestry fund managed by the "Moldsilva" Agency. These Government Decisions have been passed in conformity with the Forestry Code[157] provisions for sensible, timely and efficient use of exploitable wood mass, improving the condition and eco-protective functions of forests. Harvesting of wood in the forests of Republic of Moldova takes place during cutting of secondary products (clearing, cleaning, pruning, thinning) and logging of main products (regeneration, conservation, cleaning), as well as ecological reconstruction. The works are carried out in accordance with the planned forestry practices, the amounts of wood to be harvested being approved by the Ministry of Agriculture, Regional Development and Environment annually.

3.5.7. Waste Sector

As a rule, reducing GHG emissions in the waste sector is seen as possible by three ways: reducing methane emissions from solid waste disposal sites and from wastewater treatment plants; re-use and recycling of biodegradable waste; recovery

[153] Report on the status of the forestry fund and results of "Moldsilva" Agency's activity in 2010-2015, Chisinau, 2016.
[154] The Land Reclamation and Soils Fertility Enhancement Program. Government Decision no. 636 of 26.05.2003. Official Gazette No. 99-103 of 06.06.2003.

[155] Government decision No. 1184 22 December 2010 approving the possibility of harvesting the timber in the process of illegal logging of main products for the period 2011-2015. Official Gazette No. 254-256 from 24.12.2010.
[156] Government decision No. 890 dated December 28, 2015 approving the possibility of harvesting the timber in the process of illegal logging of main products for the period 2016-2020. Official Gazette No. 370-376 from 31.12.2015.
[157] Forestry code. Low no. 887-XIII din 21 June 1996. Official Gazette No. 4-5 from 16.01.1997.

of energy from waste and wastewater, which substitutes for energy obtained by burning fossil fuels.

To illustrate the importance of waste in terms of its impact on the environment, it should be mentioned that waste contribute to formation of 54.9% of total methane and 5.1% of the nitrous oxide emissions formed at the national level, the contribution of the sector being approximately 12.2% of total GHG emissions in 2013.

Reduction of these emissions is possible by redirecting as large as possible amounts of biodegradable waste away from the waste disposal sites. This can be achieved by encouraging recycling of waste and increasing of energy recovery from waste. So, in conformity with art. 56 of the Law on Waste no. 209 of 29.07.2016, new regulations on biodegradable waste management have been issued. According to these regulations, biodegradable waste is defined as waste „coming from gardens and parks, food waste or waste from households, restaurants, catering companies or retail outlets, which is compatible with waste coming from food processing enterprises".

Wastewater also has a pool of reserves for the GHG emissions reduction. Thus, approximately 14.2% of total GHG emissions from the "Waste" sector are assigned to wastewater. The way of reducing GHG emissions from the wastewater is seen by eliminating the anaerobic treatment from the sewage waters purification operation or by capturing the methane generated in this process. Currently, the legal framework does not set forth any requirements for reducing GHG emissions in the process of collection, purification and wastewater discharge, it does not regulate the exploitation of the sludge fields at the treatment plants aimed at reducing the relevant emissions.

Policy and Legislative-Normative Framework

The approximately 50 legislative documents and more than 60 Government Decisions approved so far in the field of environmental protection have not been specifically intended to achieving the above-mentioned objectives, being only tangentially relevant. The Low Emissions Development Strategy until 2030 and the Action Plan for its implementation published in March 2017, is an exception. At the same time, policies aimed at discouraging storage of waste on landfills and encouraging recycling, providing sewerage services for the urban area and social facilities in the rural area, deserve more attention. Such a way to reduce GHG emissions has proven to be most effective in countries with good waste management practices[158]. In this respect we will mention a few, the most relevant of the national normative acts, which promote such measures:

- The Law on Environmental Pollution Payments[159], approved in 1998 and updated over time, including in 2017, provide for:
  - payments for waste disposal, but only for waste that cause N_2O, CO_2 and CH_4 emissions, which are not on the list of "Coefficients of aggressiveness for some pollutants emitted into atmospheric air".
  - payments for deposits of waste from pig breeding facilities and farms, ranging from 0.024 minimum wages /m^3 (with screen shield), to 0.05 minimum wages/m^3 (without screen shield). Respectively, for the cattle breeding facilities and farms: 0.006-0.012 minimum wages/m^3, and for poultry farms 0.003-0.006 minimum wages/m^3. Analysis of these figures show that payments have been calculated taking into consideration the impact of waste on the soil, underground water and other components of the environment, but not on climate change, given the fact that emissions from such biomass show higher values when stored with screen shields. Smaller payments are charged for this type of storages, which is encouraging rather than discouraging emission of CH_4 in the atmosphere.
  - payments for discharge of pollutants with wastewater, set at a fixed level, without specifying the impact of each pollutant on climate change. For example, for the Chisinau municipality 234 lei (about us $12.6) is charged for one conventional ton of discharged wastewater.
- The Law on Industrial and Household Waste[160], also updated in 2016, provide for storage of waste against payment, however, the payments are not established. The only existing payments are payments for environmental pollution, but these can be obtained only through the court. These payments are paid based on calculations made by environmental inspectors, and shall be paid into the National Ecological Fund. At the same time, there is no clearly defined regime for storing waste at solid waste disposal sites (SWDS), and the source for the rehabilitation of SWDS land is not determined. Non-differentiated payments do not encourage companies to reduce the amount of waste produced and discharged in landfills.
- The Law on Atmospheric Air protection[161] provides for payments for exceeding the maximum admissible concentration of pollutants in the atmosphere. However, greenhouse gases are not included into the monitored category, as specified in the Instruction on the Assessment of Air Pollution Damage caused by Pollution by Stationary Sources[162]. At the same time, another instruction approved in 2004, namely the Instruction on the Assessment of Air Pollution Damage due to Management of Industrial and Household Waste[163], expressly provides for this payment, which is calculated based on the concept that one tone of CO_2 costs 18 lei. In fact, it is difficult to charge this payment, given the fact that it is necessary to have laboratory proof, while technical capabilities to do the necessary analyses are missing. As a result, this payment have not been applied so far.
- Water Supply and Sanitation Strategy (2014 – 2028), approved by the Government Decision no. 199 of 20 March 2014[164], which aims to present an updated and detailed route of water supply and sanitation sector development,

[158] The UK's Fifth National Communication under the United Nations Framework Convention on Climate Change. 2009

[159] The Law on Environmental Pollution Payments, No.1540-XIIIof 25.02.98, Official Gazette of the RM No.54-55/378 of 18.06.1998.

[160] The Law No.1347-XIII of 09.10.1997 on Industrial and Household Waste. Official Gazette No. 16-17 of 05.03.1998.

[161] The Law on Protection of Atmospheric Air, No. 1422 of 17.12.1997. Official Gazette No. 44-46 of 21.05.1998.

[162] Assessment of Air Pollution Damage caused by Pollution by Stationary Sources of 16.08.04 no. 381. Ministry of Environment. Official Gazette No. 186 of October 15.

[163] Assessment of Air Pollution Damage due to Management of Industrial and Household Waste 08.06.2004. Ministry of Environment. Official Gazette No. 189-192/384 of 22.10.2004.

[164] <http://lex.justice.md/md/352311/>

both in the medium term (until 2018), and in the long term (until 2028), as well as contribute to insuring the human right to safe drinking water, as a fundamental right.

- The Regulation on Regulation regarding the conditions for waste water discharge in water bodies, approved by the Government Decision no. 802 of 9 October 2013[165], encourages the application of the general measures and the best available techniques for:
  - banning or reducing discharges of wastewater that refers to the use of liquid industrial residues or sub-flows with high concentration of wastewater for the production of energy (e.g. biogas);
  - banning or reducing discharges of wastewater if it is possible to use it for insulation of animal feeders, for production of fertilizers, use it for correcting the soil structure, or production of energy.
- The Law on Waste, no. 209, of 29.07.2016[166] sets forth the legal basis, the state policy and actions needed to be undertaken for the protection of the environment and population health by preventing or reducing the effects derived from generation and management of waste. The Law transposes Directive 2008/98/EC of the European Parliament and a number of provisions from 9 EU acts, creating a platform for taking over or transposing into national legislation the provisions of these acts provided for in the Association Agreement, and the agreement on creation of deep and comprehensive free trade area (DCFTA), which is an integral part of the Association Agreement. The Law imposes new regulations, including those looking at ensuring separate collection of bio-waste with a view to their composting and fermentation; treating bio-waste in a way ensuring high level of environmental protection; use of environmental safe materials produced from bio-waste. At the same time biodegradable waste from parks and gardens must be collected separately and transported to composting stations or to individual composting platforms. During 2017 the Ministry of Agriculture, Regional Development and Environment will develop the framework of secondary legislation and promote it to the Government for approval before the end of the year.
- The Waste Management Strategy of the Republic of Moldova for 2013-2027[167] promotes a new manner of collecting household and industrial waste, recovery of reusable materials, environmental protection and implementation of a unitary street sanitation program, which would contribute to the reduction of the amount of waste deposited in the respective areas, by establishing an appropriate treatment system for each type of waste in order to protect the environment. The overall objectives of the Strategy are: development of integrated waste management system by harmonizing the legal, institutional and regulatory framework to the EU standards, based on regional approach and territorial division of the country in 8 of waste management regions. Also, the Strategy provides for the development of regional infrastructure to eliminate domestic solid waste and for transfer stations, in accordance EU Member States practices. Construction of regional solid waste sites shall be carried out under new rules approved by the regulation on waste disposal, based on the Law on Waste no. 209 of 29.07.2016 and transposition of Directive no. 1999/31/EC on Waste Disposal.

Specific objectives for waste generating GHG emissions, i.e. vegetal waste, manure, waste from woodworking and others are as follows: (a) to encourage use by aerobic and anaerobic composting and building waste composting and fermentation capacities, at least one per rayon; (b) support for using waste for energy purposes, where capitalization is not feasible from technical and economic view, safely for the health of population and environment.

To achieve these objectives it is planned to: (1) create networks for separate waste collection of vegetal waste, manure, waste from woodworking; (2) promote projects related to use of vegetal waste for energy purposes, where capitalization is not feasible; (3) capacity building for collection of packaging waste.

The strategy promotes, at the same time, a system of information, awareness and motivation for all parties involved, including for undertakings engaged in waste management.

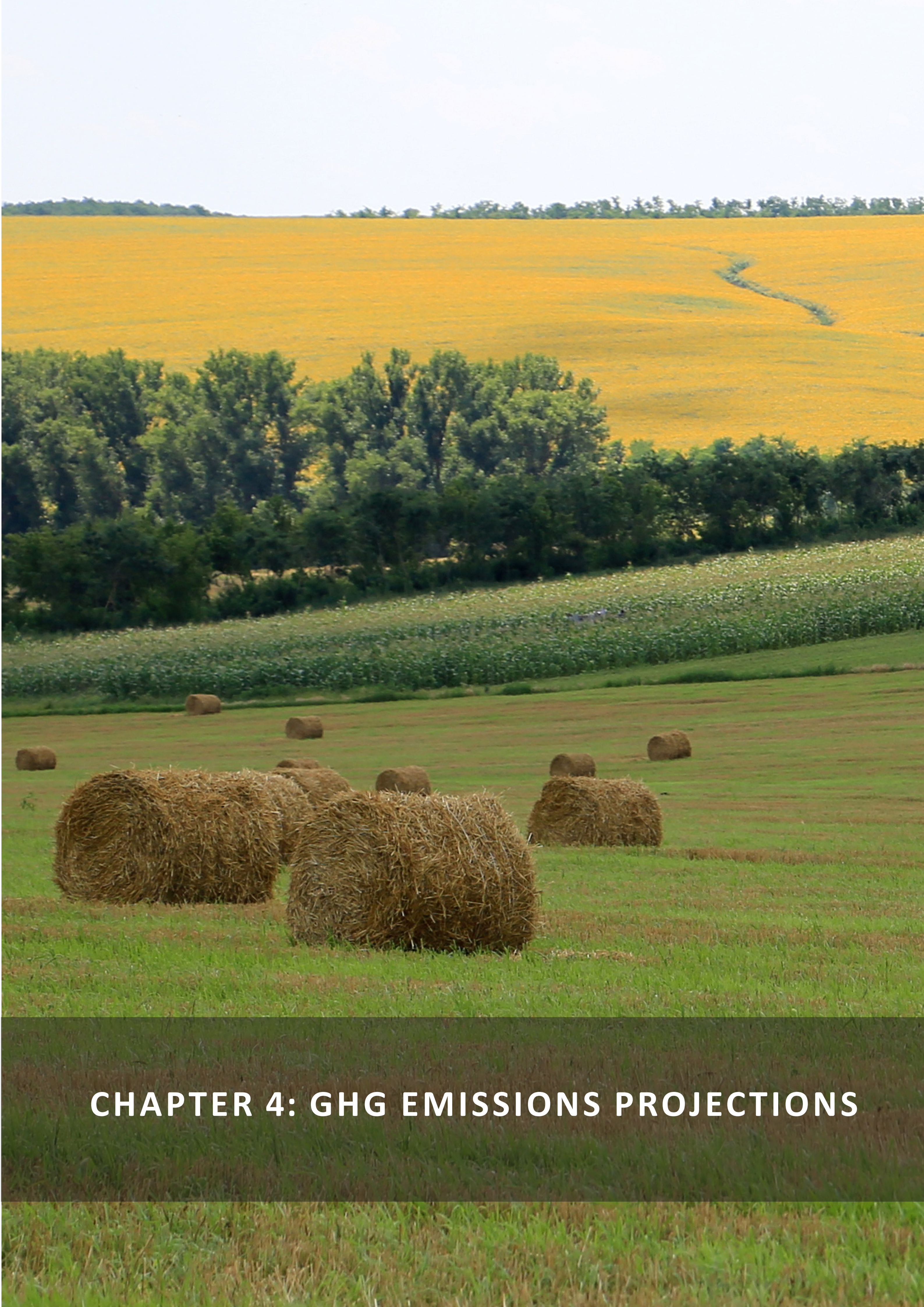
Clean Development Mechanism Projects of the Kyoto Protocol

Two nationwide projects aimed at reducing GHG emissions generated by residues have been proposed under the CDM of the Kyoto Protocol. The first is designed to focus on fermentation of biodegradable waste at a sugar factory. The produced biogas will be used to generate electricity. The second project provides for burning a portion of the generated methane and using the remaining part of biogas collected from the solid waste deposit site for producing electricity.

According to the first project "Production of biogas from the pressed sugar beet pulp at the sugar refinery Südzucker Moldova" (Drochia, Republic of Moldova), it is planned to reduce the GHG emissions produced in the process of decomposing sugar beet residues, with about 8 thousand tons of CO_2 equivalent in the first year of project implementation and 32 thousand tons of CO_2 equivalent in the 10^{th} year.

The second project is aimed at "Capturing of biogas and production of electricity at the solid waste deposit site Tintareni" (Chisinau, Moldova). The project was launched by "TEVAS GRUP" SRL. In the first year of lending it is planned to reduce about 53 thousand tons of CO_2 equivalent, and in the 10^{th} year - about 47 thousand tons of CO_2 equivalent.

[165] Government Decision no. 802 of 9 October 2013 on approval of the Regulation on conditions of wastewater discharge into the water bodies, Official Gazette no. 243-247/ 931 of 01.11.2013
[166] The Law on Waste No. 209, of29.07.2016, Official Gazette No. 459-471/916 of 23.12.2016
[167] Government Decision No. 248 of 10.04.2013 on approval of Waste Management Strategy of the Republic of Moldova for 2013-2027. Official Gazette No. 82 of 12.04.2013.



CHAPTER 4: GHG EMISSIONS PROJECTIONS

CHAPTER 4: GHG EMISSIONS PROJECTIONS

4.1. Medium and Long-Term Projections of Direct GHG Emissions

The GHG emissions projections developed for the Fourth National Communication (NC4) of the RM under the UNFCCC have taken into account the impact of promotion of mitigation policies and measures mentioned above in Chapter 3, including in the Low Emissions Development Strategy (LEDS) of the Republic of Moldova until 2030 and the Action Plan for its Implementation, where sectoral targets are also embedded.

Table 4-1 shows the historic emissions (1990-2015), as well as emissions projections for the With Measures (WM) scenario, for the period until 2030. WM scenario complies with the accomplishment of the unconditional Intended Nationally Determined Contribution (INDC) under the Paris Agreement. As noted in Chapter 3, and according to the INDC, the Republic of Moldova commits to achieve, by the year 2030, the unconditional target of at least 64% reduction in net GHG emissions compared to the level of 1990.

Historical emissions from the Table 4-1 are in line with those included in the "National Inventory Report, 1990-2015. GHG Sources and Sinks in the Republic of Moldova" (2017). Both the historical data and GHG emissions projections cover the entire country, including the Administrative Territorial Units on the Left Bank of the Dniester River (ATULBD).

Table 4-1: GHG emissions in the Republic of Moldova, kt CO_2 equivalent

GHGs	1990	1995	2000	2005	2010	2015	2020	2025	2030
CO_2 (net emissions)	29 013	5 037	320	3 621	6 360	6 492	7 390	8 969	10 512
CH_4	5 706	4 169	3 322	3 303	2 914	2 863	3 180	2 872	2 946
N_2O	2 861	1 956	1 499	1 760	1 644	1 573	1 870	1 972	2 110
F-gases	-	5	10	42	113	179	302	399	516
Net GHG emissions	37 580	11 167	5 151	8 726	11 031	11 108	12 741	14 212	16 086
Changes compared to 1990, %		-70	-86	-77	-71	-70	-66	-62	-57

The country's progress in attaining the mitigation goals is assessed against the baseline year (1990), when the amount of direct GHG emissions was 43,400 kt CO_2 equivalent (excluding the contribution of the LULUCF sector), with the net GHG emissions accounting for 37,580 kt CO_2 equivalent. As shown in Table 4-1, in 2015 the level of net emissions was by 71% lower than in 1990. By the year 2030 the share concerned will decrease to 57%, what is explained by revitalization of the national economy that has been in regression a good part of the time in the last 25 years.

Over the years the structure of GHG emissions has also changed, the share of carbon dioxide emissions is higher than the share of CH_4 and N_2O emissions which show a slow downward trend compared to the peak values features in 1990-2015, while F-gases showing a steady growth over the entire period of 2005-2030 (Figure 4.1)

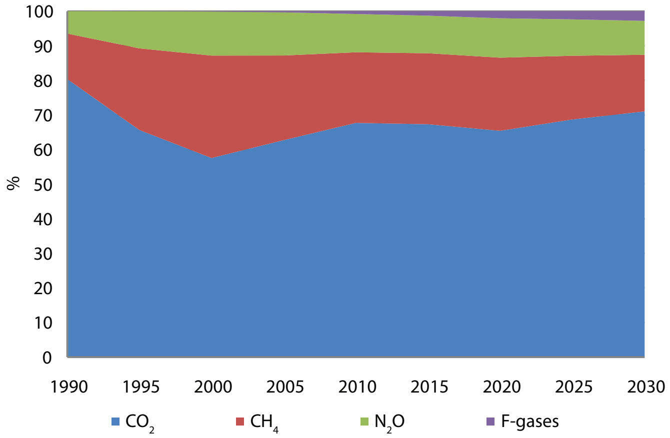


Figure 4-1: Structure of total GHG emissions in the RM in 1990-2030.

If in 1990 the share of CO_2 emissions (with the contribution of the LULUCF sector) accounted for about 80.4% of the total GHG emissions in the RM, in 2015 it was only about 67.3% of the total, while in 2030 the level of CO_2 emissions is expected to reach 69% of the total. These changes are caused, on the one hand, by the increasing contribution of the LULUCF sector to the CO_2 emissions removal, on the other hand - by the growth of other direct GHG emissions, in particular F-gases, on the one hand, and CH_4 and N_2O emissions on the other hand, as a consequence of agriculture development, mainly animal husbandry (emissions from enteric fermentation and waste management), and application of mineral fertilizers in agricultural soils cultivation, as well as the increase of the living standards, with direct impact on the level of solid waste generation.

4.2. Methods and Tools Used to Assess the Mitigation Potential

The GHG emissions projections have been developed for three scenarios: (1) Business-As-Usual (BAU); (2) With Measures (WM); and (3) With Additional Measures (WAM), taking into account the fact that demonstration of mitigation potential by comparison may better mobilize the decision makers towards the achievement of objectives.

It should be noted, that drafting of mitigation scenarios, in particular the BAU and WAM was been somewhat affected by the uncertainty of some socio-economic factors evolution, with major impact on the level of GHG emissions in the long term, as well as the ability to identify long-term appropriate mitigation opportunities.

The GHG emissions mitigation potential was assessed based on top-down and bottom up approach with the help of computer tools.

Mitigation scenarios were developed for each individual sector (Energy, Transport, Industry, Agriculture, LULUCF and Waste), and GHG emissions were estimated separately for each gas (CO_2, CH_4, N_2O, HFC, PFC and SF_6).

The list of the tools considered, and selected for use, along with a brief choice argumentation, is presented in Table 4-2.

Table 4-2: Tools used to assess GHG emissions mitigation potential in the Republic of Moldova

Sector	Recom-mended tools	Tools used	Notes
Energy	MESSAGE, MARKAL, EN-PEP-BAL-ANCE, LEAP, RETScren	ENPEP, together with the WASP, IMPACT 2006 IPCC Guidelines software	1) for the electricity subsector the electricity sources development scenarios were calculated with the WASP, while the GHG emissions mitigation potential – with IMPACT; 2) for the electricity and transport subsector the GHG emissions mitigation potential was calculated applying Excel spreadsheet developed by sector experts, as well as the 2006 IPCC Guidelines software;
Industry	LEAP	2006 IPCC Guidelines software, Land Use Matrix	For the industry, agriculture and LULUCF subsectors GHG emissions mitigation potential was calculated using Excel spreadsheet developed by the sector experts, applying calculation methodology from IPCC Guidance 2006, as well as the 2006 IPCC Guidelines software
Agriculture	STAIR		
LULUCF	COPATH		
Waste	LEAP	The 2006 IPCC Guidelines software, IPCC First Order Decay Method	To assess the potential to mitigate methane emissions from solid waste disposal sites, Excel spreadsheet developed by sector experts was used, applying the IPCC First Order Decay Methodology from IPCC Guidance 2006, as well as the 2006 IPCC Guidelines software; To assess the potential to mitigate methane and nitrous oxide resulting from wastewater treatment, standard calculation methodology from 2006 IPCC Guidelines and the respective software were used

4.3. Medium Term Projections of Direct GHG emissions by Sector

4.3.1. Energy Sector

In the energy sector the projections and mitigation actions have been identified separately for GHG emissions from stationary combustion of fossil fuels (electricity and thermal energy sector) and GHG emissions from the mobile combustion of fuels (transport sector). Fugitive emissions from oil and gas operations, including extraction, processing, transportation and distribution of oil and natural gas (gas and oil products supply sector) have been assessed at the level of the year 2015.

I. Stationary Combustion

1A. Power Subsector

The emissions mitigation reserves in the power subsector are determined based on the analysis of the three development scenarios for the electricity sources: BAU, WM and WAM. The BAU and WM scenarios are designed to cover the same energy demand over the period until 2030, which reflects the country's policies set forth in the secondary legislation in force. As for the third scenario - WAM, the energy demand projections were made taking into consideration the average annual growth of energy demand, as well as the load factor over the last 10 years.

The following considerations served as a basis for calculation of electricity demand projections: the economic growth rate, including the GDP growth rate; the trends in electricity consumption in recent years; decreasing energy losses in the transmission and distribution network, including unaccounted energy consumption; increasing load factor of the system as a result of energy consumption optimization and growth of energy demand in the peak season due to the increased use of air conditioners; the application in the near future of zonal and binomial tariffs, all aimed at flattening the consumption load curve.

Load curve projections were developed based on the analysis of load curve of the power system of the RM in the past 5 years, and other parameters which allow the increase of the load factor, such as: technical and economic features of the current energy system; the fact that the power reserve will be within the limits of 10-40%; the discount rate of 10% per year.

The evolution of energy demand and the respective scenarios are shown in Table 4-3.

Table 4-3: Projections of energy demand, power, and load factor under BAU, WM and WAM

Year	BAU and WM				WAM			
	Energy demand of the RM, GWh	Demand for energy, the right side, GWh	Demand for maximum power, MW	Load factor of the RM,%	Energy demand of the RM, GWh	Demand for energy, the right side, GWh	Demand for maximum power, MW	Load factor of the RM,%
2010	5960	(3915)	1120	60.74	5960	(3915)	1120	60.74
2017	7442	5398	1394	60.94	6046	4410	1178	58.59
2018	7791	5688	1458	61.00	6178	4496	1201	58.72
2019	8158	5994	1525	61.07	6316	4584	1225	58.86
2020	8541	6314	1595	61.13	6455	4675	1250	58.95
2021	8916	6625	1664	61.17	6600	4769	1275	59.09
2022	9308	6950	1735	61.24	6752	4866	1302	59:2
2023	9716	7290	1810	61.28	6909	4967	1329	59.35
2024	10 110	7613	1881	61.36	7066	5070	1356	59.49
2025	10 519	7950	1955	61.42	7232	5177	1385	59.61
2026	10 946	8303	2033	61.46	7,400	5287	1415	59.70
2027	11 350	8630	2106	61.52	7577	5401	1445	59.86
2028	11 770	8971	2182	61.58	7756	5519	1474	60.07
2029	12 205	9325	2260	61.65	7944	5641	1502	60.38
2030	12 612	9649	2333	61.71	8136	5766	1531	60.67
2031	13 033	9984	2409	61.76	8336	5896	1560	61.00
2032	13 468	10 330	2487	61.82	8539	6030	1590	61.31
2033	13 918	10 689	2567	61.89	8750	6168	1622	61.58
2034	14 319	11 009	2639	61.94	8960	6304	1657	61.73
2035	14 677	11 284	2702	62.00	9176	6442	1694	61.85

Current energy production sources considered in all scenarios of electricity sources development in the RM are: CTEM, CHP-1, CHP-2, CHP-Nord, HPP-Costesti, HPP-Dubasari and, CHP-Tirotex (Tiraspol), CHPs at sugar factories, renewable energy sources constructed prior to beginning of 2017 and in operation now.

The Business-As-Usual (BAU) scenario includes all existent plants, which until 2019 show average efficiency growth demonstrated in the past 5-7 years, including negative growth. Starting with the year 2020 the existing local power plants will be rehabilitated only to maintain their lifetime until 2035. Their efficiency will stay at the level of year 2019 and will remain constant until 2035. The energy imports after 2016 will be at the level of 25% for the entire country. The price of gas and energy import will increases by 1% per annum until 2035. The CTEM will be modeled with the last 6 groups to cover the demand of both right and left banks, that is, its total available power will not exceed 1320 MW. All groups will work on natural gas. At nominal power the efficiency of 200 MW groups will be 35%, of 210 MW groups - 37%, and of 250 MW group - 40%. The BAU scenario does not provide for construction of new RES.

With Measures (WM) scenario is in line with the Energy Strategy 2030 targeted towards self-balancing. To this end, the power plants included in the WM scenario follow the BAU scenario up until 2019. By the year 2020 CHP -2 shall be rehabilitated and will maintain its power at 240 MW. In addition to CHP-2 other power plants shall be put into operation and the power and year of commissioning shall be chosen by the WASP in an optimization mode. The available electric power of the RES (wind, solar and biogas-based) during the considered timeline is presented in Table 4-4. Due to the fact that the RM lacks the electric power needed to balance the intermittent power of wind and photovoltaic plants (WPP), it is planned to build gas turbines, the power of which reaches 95% of the WPP, and which will take over this function. The CTEM only covers the energy demand in Transnistria and, as the case may be, will also cover part of the electricity consumed on the right bank of the Dniester river.

An important aspect of the WM scenario is implementation of asynchronous connection of the power system of the Republic of Moldova with Romania through the ' back-to-back" stations (up to 6 units of 250 MW each), and respectively with the ENTSO-E-European Network of Transmission System Operators, which allows for a significant diversification of sources of electricity imports for Moldova.

Until 2019 the level of energy import will stay at the level of 2016. It is expected that the price of gas and imported energy will show an upward trend with 1% increase per annum each. At the same time, once the asynchronous interconnection with Romania becomes operational in 2020, the price for imported energy will decrease by 0.6 cents/kWh, an average discrepancy in the price of energy purchased by suppliers on the territory controlled by the Moldovan authorities and the average market price of Romania in recent years.

With Additional Measures (WAM) scenario practically follows the WM scenario described above, except for the following: covering a smaller energy and power demand over years (Table 4-3); construction of renewable power plants of much bigger power than under the WM scenario, of circa 1026 MW by 2030, versus 426 MW under the WM scenario (Table 4-4); construction of "back-to-back" stations of smaller capacity, up to 6 units of 174 MW each.

Table 4-4: RES available power under the BAU, WM and WAM

Year	2020		2025		2030		2035	
Scenarios/ SRE	WM	WAM	WM	WAM	WM	WAM	WM	WAM
WPP	152.1	152.1	277.1	477.13	402.1	802 .1	527.1	1127.1
Photovoltaic	3.8.	3.8.	11.2	59.8	19.2	199.8	27.2.	349.8
Biogas plants	3.6	3.6	5.0	5.6	5.0	24.6.	5.0	24.6.

The scenarios were evaluated and optimized using the ENPEP model developed by the International Atomic Energy Agency. This tool allows undertaking the full range of tests required to determine the effect of GHG emissions reduction through the complexity of retrofitting and construction of new plants in the energy system. The WASP model, which is an integral part of ENPEP, allows to optimally choosing the power sources that need to be built or retrofitted during the period under consideration. The WASP chooses the sources automatically, from the previously determined list, the power and year of implementation of the chosen source, by using the method of dynamic programming. The candidate groups participating in identification of the optimal solution for the development of electricity sources are presented in Table 4-5.

The results obtained in this study are automatically transferred into the IMPACT model (another component of the ENPEP), intended for the determination of harmful emissions from the plants selected by WASP.

Table 4-5: List of candidate groups, participating in the WASP optimization process

	Capacity, MW		The number of groups available
	WM	WAM	
TG Rolls-Royce	51	51	∞
CC Siemens	100	100	∞
CC Westinghouse Electric	175	175	∞
CC Siemens	200	200	∞
New CHPs, distributed production	2	1	∞
Construction CHP 3	125	125	2
Building of photovoltaic plant	1.6	1.6	∞
Building of wind power plant	2.5	5	∞
Upgrading of CHP 1	24	24	1
Possibility of building the TG at the CHP Nord	38	38	2
Import of electricity, back-to-back stations	250	174	5

I.A.1. Technical and Economic Calculations

The main technical and economic indicators under the considered scenarios, the structure of power plants determined by WASP for each scenario, the capacity of the plants and the years in which they are put into operation are presented in Table 4-6.

Table 4-6: Economic and technical parameters of the scenarios

Parameters		BAU	WM	WAM
Net Present Value (mil. USD)	2010-2015	1935.2	1833.5	1729.6
	2010-2025	3947.9	4244.7	3725.4
	2010-2035	5115.5	5407.4	4610.8
Present Value of capital investments (mil. USD)	2010-2015	196.0	89.0	84,9
	2010-2025	368.4	725.8	694.9
	2010-2035	369.4	861.3	995.7
Development options selected by WASP				
CHPD	2010-2015	44 (x 2 MW)	0	0
	2010-2025	74 (x 2 MW)	0	20 (x 1MW)
	2010-2035	74 (x 2 MW)	0	20 (x 1MW)
CHP1	2010-2015	0	0	0
24 MW	2010-2025	1	0	0
	2010-2035	1	0	0
CCSS (CHP2)	2010-2015	0	0	0
100MW	2010-2025	2	1	1
	2010-2035	2	1	1
CB2N	2010-2015	0	0	0
38MW	2010-2025	2	0	0
	2010-2035	2	0	0
SOLAR	2010-2015	0	0	0
	2010-2025	0	8 (x 1.6 MW)	39 (x 1.6 MW)
	2010-2035	0	18 (x 1.6 MW)	219 (x 1.6 MW)
WIND	2010-2015	0	1 (x 2.5 MW)	0
2.5 MW (5)	2010-2025	0	110 (x 2.5 MW)	95 (x 5 MW)
	2010-2035	0	210 (x 2.5 MW)	210 (x 5 MW)
CC2M (CHP3) 200 MW	2010-2015	0	0	0
	2010-2025	0	2	0
	2010-2035	0	2	0
CHP3 80 MW	2010-2015	0	0	0
	2010-2025	0	3	3
	2010-2035	0	3	3
IMPORT BtB station	2010-2015	0	0	0
	2010-2025	0	3 (x 250MW)	3 (x 174MW)
	2010-2035	0	5 (x 250MW)	3 (x 174MW)
Import of electricity (GWh/% of total)	2010-2015	6518/17.2%	6509/17.2%	4767/13.6%
	2010-2025	29 127/23.2%	21 908/17.0%	13 208/13.3%
	2010-2035	62 994/24.8%	48 857/19.3%	14 907/8.3%
Present Value of generated energy (GWh)	2010-2015	28 620		26 854
	2010-2025	59 412		50 261
	2010-2035	76 949		61 628
The average value of electricity price ($/MWh)	2010-2015	67.62	64.06	64.41
	2010-2025	66.45	71.44	74.12
	2010-2035	66.48	70.27	74.82

The timing of investments in developing the electricity sources under the developed scenarios are shown in Figure 4-2.

The evolution of the average annual purchase price of electricity from the sources over the period of the study, depending on the scenario, is shown in Figure 4-3.

According to Table 4-6, the WM scenario provides for the construction of 100 MW combined cycle power plant, with 100 MW unit operational until 2020. Commissioning of renewable sources shall take place gradually, starting with the wind plants of 152.1 MW in the period until year 2020 and reaching 277.1 MW by year 2025, and 402.1 MW by year 2030; the photovoltaic of 3.8 MW by year 2020, 11.2 MW by year 2025 and 19.2 MW by year 2030; biogas - 3.6 MW by year 2020, 5 MW by year 2025, without any other built until 2030. To ensure the balancing energy for these sources, gas turbines of about 400 MW will be commissioned by the year 2030. The need for gas turbines could partly or wholly lapse depending on the availability of access to balancing energy from Romania or other sources.

For the WAM data - see Table 4-4 and 4-6. The present value of investment required for the next eight years, i.e. until 2025, is US$ 368.4 million for the BAU, US$ 725.8 million for WM and US$ 694.9 million for the WAM.

I.A.2. Assessment of Mitigation Potential

GHG emissions expressed in CO_2 equivalent for all scenarios were calculated using the methodological approaches and emission factors available in the 2006 IPCC Guidelines. In all scenarios the conventional fuel used to produce electricity was natural gas and limited quantities of fuel oil (max. 0.02% of the total). Table 4-7 features natural gas consumption values to produce electricity under the BAU, WM and WAM scenarios over the years under review, Table 4-8 features gas emissions by categories and years, and Figure 4-4 features the totals by scenarios.

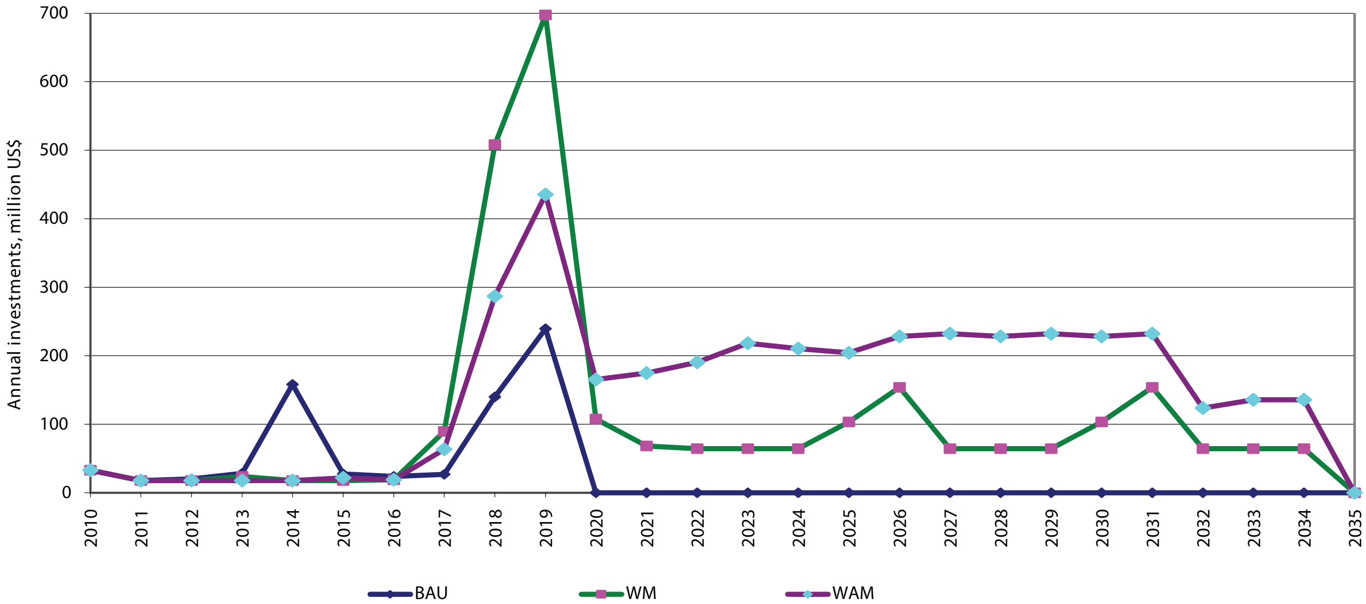


Figure 4.2: Timing of investments to accomplish the electricity sources development scenarios for the RM

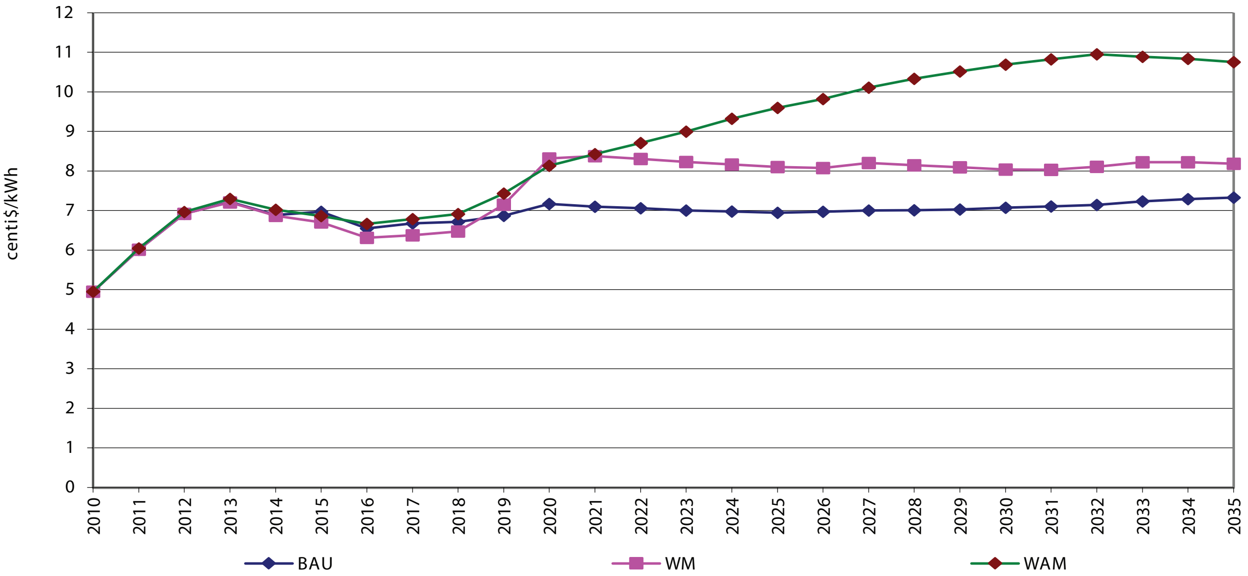


Figure 4-3: Evolution of the average price for the electricity under the electricity sources development scenarios for the RM

Table 4-7: Natural gas used for production of electricity, mil t.c.e.

Scenarios	2010	2015	2020	2025	2030
BAU	1.90	1.37	1.63	2.01	2.57
WM	1.90	1.43	1.83	2.11	2.35
WAM	1.90	1.42	1.36	1.50	1.53

Table 4-8: Amount of GHG generated from production of electricity under the BAU, WM and WAM scenarios, kt CO_2 equivalent

Scenarios	Gas type	2010	2015	2020	2025	2030
BAU	CO_2	3116.0	2258.8	2681.0	3298.9	4220.6
	CH_4	1.2	0.8	1.0	1.2	1.6
	N_2O	1.7	1.2	1.5	1.8	2.3
Total	**CO_2 eq.**	**3118.9**	**2260.9**	**2683.4**	**3301.9**	**4224.5**
WM	CO_2	3116	2380	3026	3507	3897
	CH_4	1.2	0.9	1.1	1.3	1.5
	N_2O	1.7	1.3	1.7	1.9	2.2
Total	**CO_2 eq.**	**3118.9**	**2381.9**	**3029.0**	**3510.5**	**3901.0**
WAM	CO_2	3116	2333	2231	2462	2519
	CH_4	1.2	0.9	0.8	0.9	0.9
	N_2O	1.7	1.3	1.2	1.4	1.4
Total	**CO_2 eq.**	**3118.9**	**2335.5**	**2232.7**	**2464.0**	**2521.4**

As seen by the year 2030, the BAU scenario creates the largest amount of GHG emissions, while the smallest amount corresponds to the WAM scenario for the entire period under review, due to the promotion of renewable energy sources.

I.B. Thermal Power Subsector

In the energy sector of the RM the thermal energy subsector accounts for approximately 23% of the total GHG emissions at the national level. The main thermal energy consumers are the residential and tertiary sector (for heating, domestic hot water and food preparation), manufacturing industry and construction, agriculture and fisheries. Production of thermal energy by emission categories takes place separately, centralized, and individually, with stationary fuel combustion in all categories, except for some consumers from agriculture, forestry and fisheries. Fossil fuels used to obtain thermal energy at the heat plants are natural gas, oil products, coal, and the renewable energy used for the same purpose is solar energy, biomass, geothermal energy, etc. Aiming at identifying the GHG emissions mitigation reserves in these sector 3 scenarios were considered: BAU, WM and WAM.

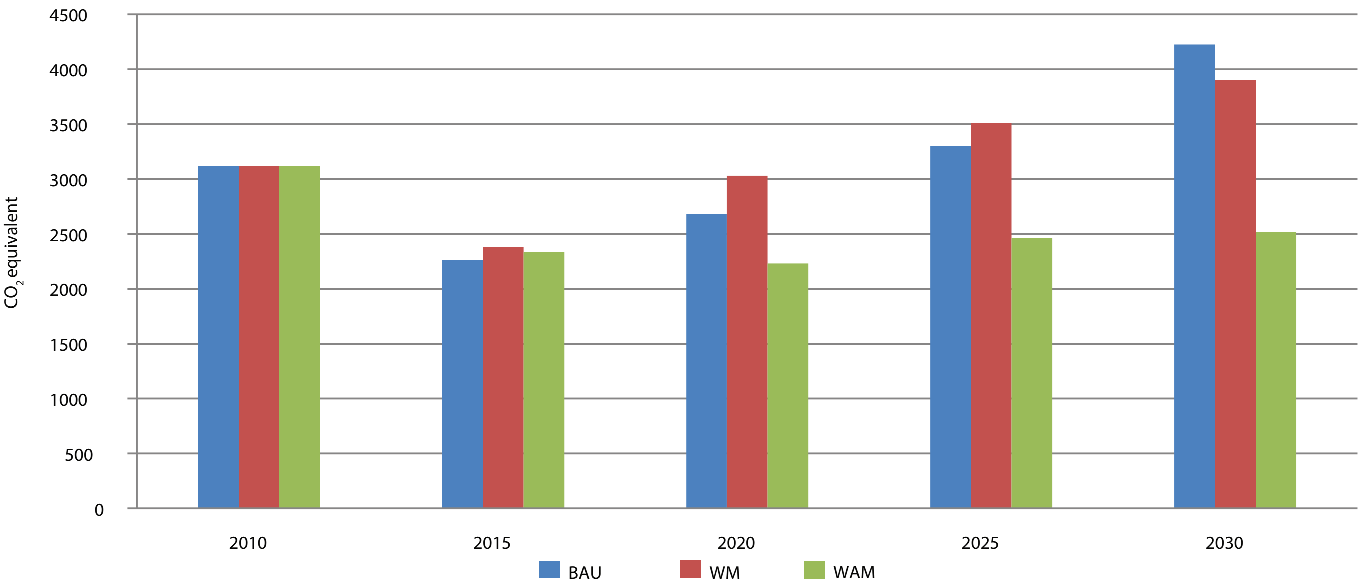


Figure 4-4: Evolution of total GHG emissions in electricity sector of the RM

The BAU scenario was developed based on energy consumptions which in turn were determined based on projections regarding the evolution of the country's population, including on the left bank of the Dniester river, and of the gross domestic product (GDP). The latter showed an average growth by 8.2% a year during the period 2011-2015, and then fell to 6.3% by the year 2020. Energy consumption was determined on the basis of forecasts made by the Ministry of Economy and Infrastructure, extrapolation of data from Statistical Yearbooks for the years 2000-2010, with consideration of trends for that period of time. Energy intensity over the period under review decreases from 1.23 kg c.e./$ SUA in the reference year 2005 to 0.60 kg c.e./$ SUA by 2030[168]. Legislative and normative acts, which entered into force recently, the relevant techniques and technologies development trends were also taken into account.

The WM scenario has been developed based on the National Development Strategy "Moldova 2020", which provides for the reduction by the year 2020 of specific energy consumption by 20%. Energy consumption reduction will be achieved as a result of thermal rehabilitation of buildings built prior to 1990; demolition of a part of such buildings and replacing them with new buildings with higher energy efficiency; improvements in the internal heat supply systems (metering by individual apartments, programmed adjusting of temperature in each separate room, etc.); improvement in heat transmission and distribution systems (streamlining the systems, reducing losses and transmission costs, etc.); increasing efficiency of heat sources (condensing boilers, co-generation plants, heat pumps). Emissions reductions will also be achieved by increasing the amounts of biomass used and solar energy.

The WAM scenario provides for accomplishing the WM scenario measures, but in larger proportions, counting on increased international donors support, higher energy efficiency, increased use of solar energy and biomass for heat production.

I.B.1. Technical and Economic Calculations

Evolution of the total energy consumption trends in the thermal energy subsector is presented in Figure 4-5 and Table 4-9, while the evolution of the types of used energy structure is presented in Figure 4-6.

Table 4-9: Structure of primary energy consumption by types of consumers, PJ

Sectors	2000	2005	2010	2015	2020	2025	2030
BAU							
Buildings	52.38	61.95	57.01	54.07	55.77	63.71	68.89
Industry	9.22	10.45	8.49	11.83	16.44	24.82	36.32
Agriculture	3.24	2.55	2.16	3.28	5.23	6.89	8.43
Total	64.84	74.95	67.66	69.18	77.44	95.42	113.64
WM							
Buildings	52.38	61.95	57.01	52.74	45.76	48.75	49.03
Industry	9.22	10.45	8.49	11.31	13.12	23.13	32.60
Agriculture	3.24	2.55	2.16	3.00	3.70	4.93	6.16
Total	64.84	74.95	67.66	67.04	62.58	76.81	87.79
WAM							
Buildings	52.38	61.95	57.01	51.95	44.54	45.5	44.08
Industry	9.22	10.45	8.49	11.31	12.62	22.43	31.70
Agriculture	3.24	2.55	2.16	3.00	3.70	4.93	6.16
Total	64.84	74.95	67.66	66.25	60.87	72.87	81.94

[168] Second National Communication of the Republic of Moldova under the UNFCCC (2010).

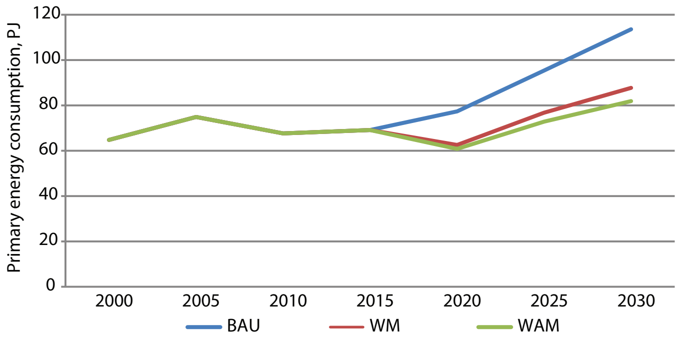


Figure 4-5: Evolution of the total energy consumption in thermal energy subsector

As seen in Figure 4-6, by the year 2030 the BAU scenario provides for a decrease of the share of natural gas uses by 12.2%, of coal – by 1.6%, increasing at the same time the share of petroleum products by 2.3% and biomass –by 13.5%. Under the WM and WAM the structure of the energy used types undergoes more important changes - 13.2; 2; 3.4 and 13.4 percentage points under the WM scenario, and 15.4; 4.8; 4 and 17.1 percentage points under the WAM scenario.

Table 4-10 shows a significant reduction of electricity consumption in WM and WAM for 2030 versus the actually registered in 2010, by 9.9 % and 66.3 % respectively.

Table 4-10: Evolution of primary energy consumption in 2030, by type of energy, versus the effective values of 2010

Energy	Effec-tive 2010	2030 BAU	2030 WM	2030 WAM	2030 BAU	2030 WM	2030 WAM
	PJ				Compared to 2010,%		
Natural gas	48.83	68.23	51.81	46.38	39.7	6.10	-5.00
LPG	2.29	2.24	2.75	2.75	2.40	20.00	20.00
Oil products	3.46	8.36	7.49	7.49	141.60	116.40	116.40
Coal	4.72	6.10	4.40	2.93	29.10	6.80	38.00
Electricity	5.28	7.45	4.76	1.78	41.00	-9.90	66.30
Solid biomass and biogas	3.07	20.42	15.75	17.73	565.10	413.10	477.60
Other renew-able sources	n/a	0.85	0.83	2.88			
TOTAL	**67.66**	**113.64**	**87.79**	**81.94**			

Figure 4-7 reflects the results of primary energy consumption calculations by sector. In 2010 circa 84.3% of consumption is accounted to centralized and individually heated buildings, where 12.6% accounted to industry sector and 3.2% to agriculture, fishery and forestry sector. By 2030, the share of buildings in the thermal energy consumption structure will diminish, both under the WM and WAM due to promotion of energy efficiency, particularly in the construction sector, and increase of heat consumption in industry due to intense development of small and medium-sized enterprises sector.

Thus, compared to the level registered in 2010, by 2030 primary energy consumption in buildings will reduce by 14% under WM and by about 23% under WAM scenarios, while industry will show an increase by about 3.8 times under WM, and 3.7 times under WAM.

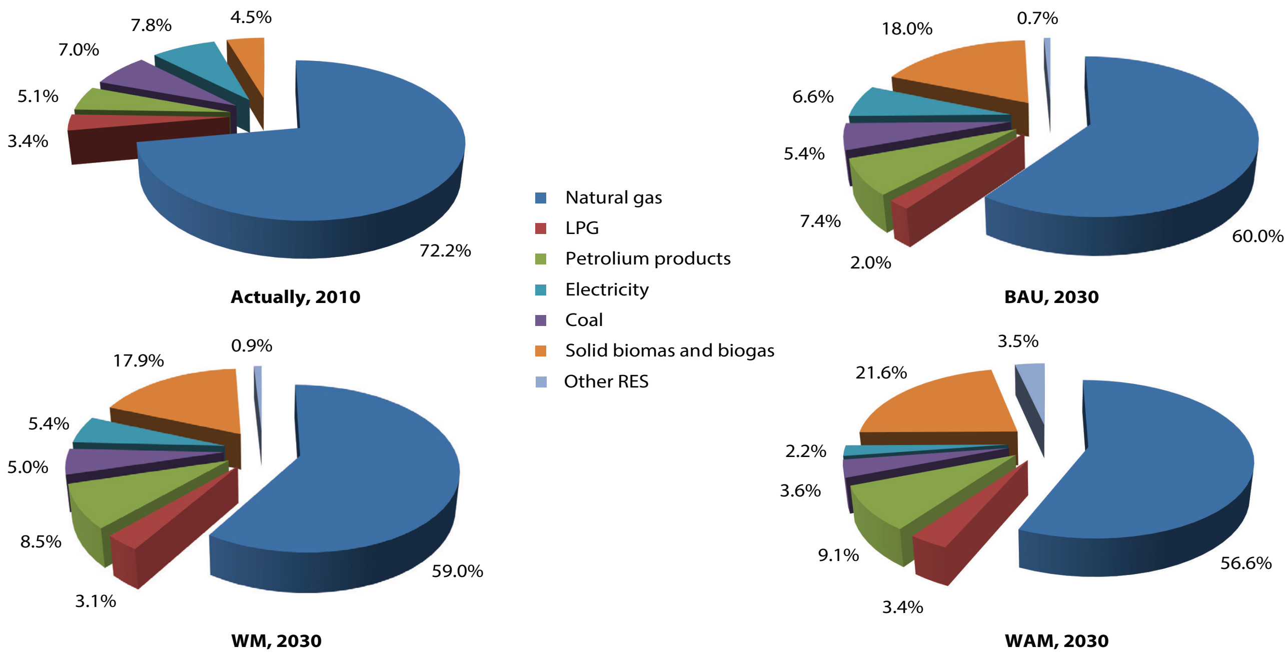


Figure 4-6: Evolution of the structure of energy resources used in thermal power subsector.

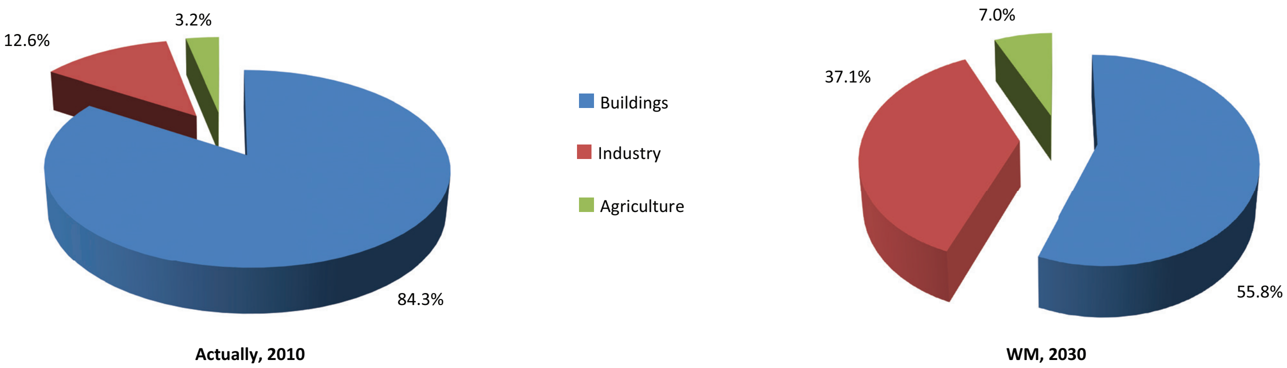


Figure 4-7: Sectors shares in the total heat consumption structure, % of total.

I.B.2. Assessment of Mitigation Potential

GHG emissions were calculated separately for each source of emissions in the thermal energy sector: 1A1aiii "Heat Plants"; 1A2 "Manufacturing industry and construction"; 1A4a "Commercial and Institutional Sectors", 1A4b "Residential Sector"; and 1A4c "Agriculture, Forestry and Fisheries", using the heat consumption calculation results by types of primary sources. Emission factors were taken from the 2006 IPCC Guidelines. The results of the calculations are presented in Figure 4-8 and Tables 4-11, 4-12 and 4-13.

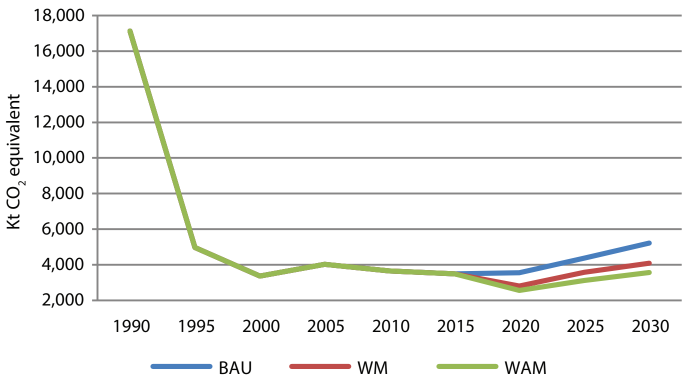


Figure 4-8: Dynamics of net GHG emissions from the thermal energy subsector.

It should be noted that net emissions do not include GHG emissions from power generation (which were calculated in the previous section), and the emissions from burning of wood and agricultural residues (in accordance with the recommendations of IPCC Guidelines (1997, 2000), these emissions are not included in the total national, and are reported for information in "Memo Items".

As seen from Table 4-11 and Table 4-12, after 2015, more than 99% of emissions in the "Thermal Energy" sector are CO_2. By 2030, the BAU scenario shows 5219.9 kt CO_2 equivalent emissions, of which 15.7% from 1A1aiii "Heat Plants"; 33.8% from 1A2 "Manufacturing and Construction Industry"; 41% from 1A4a "Commercial and Institutional Sector" and 1A4b "Residential Sector"; 9.5% from 1A4c "Agriculture, Forestry and Fisheries". Under the WM scenarios: respectively, 17.5%; 38%; 34.5%; 10.1%, and under the WAM scenario: 16.1%; 40.6%; 31.9% and 11.4% respectively.

Table 4-11: Direct GHG emissions from the Thermal Energy Sector, during 1990-2030, kt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
CO_2	16 787.63	4921.75	3326.72	3978.65	3604.02	3466.60	3523.79	4347.72	5191.97
CH_4	296.77	35.63	31.34	40.05	40.44	18.68	19.32	20.46	21.55
N_2O	44.59	10.56	6.52	7.40	7.31	4.62	4.88	5.62	6.35
Total	17 128.99	4967.94	3364.58	4026.10	3651.77	3489.90	3547.99	4373.80	5219.87
WM									
CO_2	16 787.63	4921.75	3326.72	3978.65	3604.02	3466.60	2778.27	3551.90	4065.11
CH_4	296.77	35.63	31.34	40.05	40.44	18.68	18.15	19.09	19.55
N_2O	44.59	10.56	6.52	7.40	7.31	4.62	3.89	4.47	4.93
Total	17 128.99	4967.94	3364.58	4026.10	3651.77	3489.90	2800.31	3575.46	4089.59
WAM									
CO_2	16 787.63	4921.75	3326.72	3978.65	3604.02	3466.60	2541.98	3097.81	3547.90
CH_4	296.77	35.63	31.34	40.05	40.44	18.68	10.37	7.77	6.46
N_2O	44.59	10.56	6.52	7.40	7.31	4.62	3.17	3.45	3.79
Total	17 128.99	4967.94	3364.58	4026.10	3651.77	3489.90	2555.52	3109.03	3558.15

Table 4-12: Share of different gases in the structure of total direct GHG emissions from the "Thermal Energy" sector during 1990-2030, %

	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
CO_2	98,0	99.1	98.9	98.8	98 .7	99.3	99.3	99.4	99.5
CH_4	1.7	0.7	0.9	1.0	1.1	0.5	0.5	0.5	0.4
N_2O	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WM									
CO_2	98.0	99.1	98.9	98.8	98 .7	99.3	99.2	99.3	99.4
CH_4	1.7	0.7	0.9	1.0	1.1	0.5	0.6	0.5	0.5
N_2O	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WAM									
CO_2	98.0	99.1	98.9	98.8	98 .7	99.3	99.5	99.6	99.7
CH_4	1.7.	0.7	0.9	1.0	1.1	0.5	0.4	0.2	0.2
N_2O	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Direct GHG emissions from the "Thermal Energy" sector according to emissions sources during 1990-2030 are presented in Table 4-13.

Table 4-13: Direct GHG emissions from the "Thermal Energy" sector by emission sources during 1990-2030, kt CO_2 equivalent

Categories	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
1A1aiii. Heat Production	7 307	2 290	1 312	1 157	1 080	864	760	812	820
1A2. Manufacturing industry and construction	2 214	465	538	605	541	693	844	1 234	1 763
1A4a. Commercial and Institutional and 1A4b Residential	6 129	1 500	1 288	2 078	1 874	1 712	1 634	1 920	2 139
1A4c. Agriculture, forestry and fisheries	1 479	713	227	186	157	221	311	408	498
Total	17 129	4 968	3 365	4 026	3 651	3 490	3 548	4 374	5 220
WM									
1A1aiii. Heat Production	7 307	2 290	1 312	1 157	1 080	864	570	629	714
1A2. Manufacturing industry and construction	2 214	465	538	605	541	693	675	1 126	1 552
1A4a. Commercial and Institutional and 1A4b Residential	6 129	1 500	1 288	2 078	1 874	1 712	1 307	1 489	1 410
1A4c. Agriculture, forestry and fisheries	1 479	713	227	186	157	221	249	331	414
Total	17 129	4 968	3 365	4 026	3 651	3 490	2 800	3 575	4 090
WAM									
1A1aiii. Heat Production	7 307	2 290	1 312	1 157	1 080	864	508	528	574
1A2. Manufacturing industry and construction	2 214	465	538	605	541	693	624	1 047	1 444
1A4a. Commercial and Institutional and 1A4b Residential	6 129	1 500	1 288	2 078	1 874	1 712	1,179	1 211	1 135
1A4c. Agriculture, forestry and fisheries	1 479	713	227	186	157	221	244	324	405
Total	17 129	4 968	3 365	4 026	3 651	3 490	2 556	3 109	3 558

II. Mobile Combustion

II.A. Transport Sector

In 2010 the share of transport sector in total national GHG emissions amounted to 14.3%, and in 2015 it was 15.8%. In 2015, the Transport sector consumed 369 thousand tons of fuel, including 12 million m^3 of natural gas and 49 million kWh, equivalent of 27 thousand TJ, including 66.4% diesel, 26.3% gasoline, 2.8% fuel for reactive engines, 2.3% liquefied petroleum gas, 1.6% compressed natural gas and 0.7% electricity.

Road transport mainly used diesel fuel and gasoline, to a lesser extent liquefied petroleum gas and compressed natural gas; the rail road and waterway transport used predominantly diesel fuel, and reactive engine fuel was used in air transport (it should be noted that GHG emissions from fuel combustion for reactive engines in the context of international air transport are not included in the total national GHG emissions, but are reported for information only in "Memo items").

In 2015, the structure of the total energy consumption of the transport sector is the following: 94.7% - road transport; 2.8% - air transport, 1.2% - pipeline transport, 1% - rail road transport, 0.1% waterway transport, and 0.2% - other transport related activities[169].

II.A.1 Mitigation Scenarios

The GHG emissions mitigation reserves in the transport sector were determined based on the analysis of the three of fuel consumption scenarios until 2030 - BAU, WM and WAM. The scenarios were calculated using Excel models developed by national experts, and regression analysis, including several factors of influence. In order to confirm the strong influence of each considered factor, only factors for which the P-value indicator showed values not higher than 0.05 were considered. The regression analysis was based on statistics related to the period 2000-2010. Emission factors used were taken from the 2006 IPCC Guidelines.

BAU – is based on the mitigation policies approved between 01.01.2000-01.01.2010, the same growth rate of the number of transport units as now, the increase of the passenger transport activity depending on the evolution of the population of the RM, the increase of the freight transport activity depending on the GDP evolution, as well as on activities related to the maintenance of the terrestrial and naval transport infrastructure.

WM – reflects all mitigation policies and measures implemented or adopted after 01.01.2010, including:

1) Land transport infrastructure rehabilitation, which results in 16% reduction of specific fuel consumption by the year 2020;
2) replacing diesel fuel with biodiesel at the rate of 10% by the year 2020;
3) Substitution of gasoline with bioethanol at the rate of 10% by the year 2020;
4) Rehabilitation and upgrading of infrastructure and the rolling stock of the rail transport, with 20% reduction in fuel consumption;
5) Promoting the tires labeling, purchasing energy efficient transport means, streamlining the traffic on the central streets of towns and villages, measures leading to 7.5% reduction of fuel consumption by the year 2030.

WAM – considers the mitigation policies and measures planned to be adopted until 2030. In addition to the measures mentioned in the scenario with measures, the following additional assumptions were considered:

1) Modernization and optimization of the urban public transport entailing 1.5% reduction of fuel consumption by 2030;
2) Promotion of cycling, entailing 0.1% reduction of fuel consumption in the transport sector by 2030;
3) Promoting the use of hybrid-powered buses and mini-buses, entailing 0.8% reduction of fuel consumption in the transport sector.

II.A.2. Projections of Fuels Consumption

Calculation of fuel consumption for the period under review was carried out by extrapolating statistical data for the years 2000-2010. The national GDP and the population growth rate, as well as goods and passengers traffic were also taken into account. Table 4-14 contains the results of the extrapolation of the number of private transport units included in the fuel consumption projections for the transport sector for the 2010-2030 timeline.

Table 4-14: Dynamics of the number of private road transport units in the RM during 2010-2030, thousand units

	2010	2015	2020	2025	2030
The number of private road transport units	507	607	707	807	907

In comparison with year 2010, a 49% increase in passenger traffic intensity and 47% in freight traffic intensity is expected in the 2030 perspective. As projected, a 97% increase in fuel consumption is anticipated for the 2010-2030 timeline. The dynamics and structure of fuel consumption is presented in Table 4-15 and Figure 4-9.

Table 4-15: Dynamics and structure of fuel consumption in the transport sector for the 2010-2030 timeline, PJ

Scenario	Fuel type	2010	2015	2020	2025	2030
BAU	Diesel fuel	17.3	14.5	15.2	17.0	18.8
	Gasoline	10.1	11.0	10.9	12.0	13.2
	Liquefied Petroleum Gases	0.8	0.7	0.8	0.8	0.9
	Natural Gas	0.1	0.3	0.3	0.4	0.4
	Biofuels	0.0	2.8	6.5	7.2	8.0
	TOTAL	**28.3**	**29.3**	**33.7**	**37.4**	**41.3**
WM	Diesel fuel	17.3	14.3	13.9	15.2	16.5
	Gasoline	10.1	10.8	10.0	10.8	11.5
	Liquefied Petroleum Gases	0.8	0.6	0.6	0.6	0.7
	Natural Gas	0.1	0.2	0.3	0.3	0.3
	Biofuels	0.0	0.3	2.7	2.9	3.1
	TOTAL	**28.3**	**26.3**	**27.5**	**29.8**	**32.1**
WAM	Diesel fuel	17.3	13.0	11.9	12.9	14.0
	Gasoline	10.1	9.8	8.8	9.5	10.1
	Liquefied Petroleum Gases	0.8	0.6	0.6	0.6	0.7
	Natural Gas	0.1	0.2	0.3	0.3	0.3
	Biofuels	0.0	2.5	5.2	5.6	6.0
	TOTAL	**28.3**	**26.2**	**26.8**	**28.9**	**31.1**

[169] National Bureau of Statistics of the Republic of Moldova. Energy Balance of the Republic of Moldova, 2015. Statistics Collection. Chisinau, 2016.

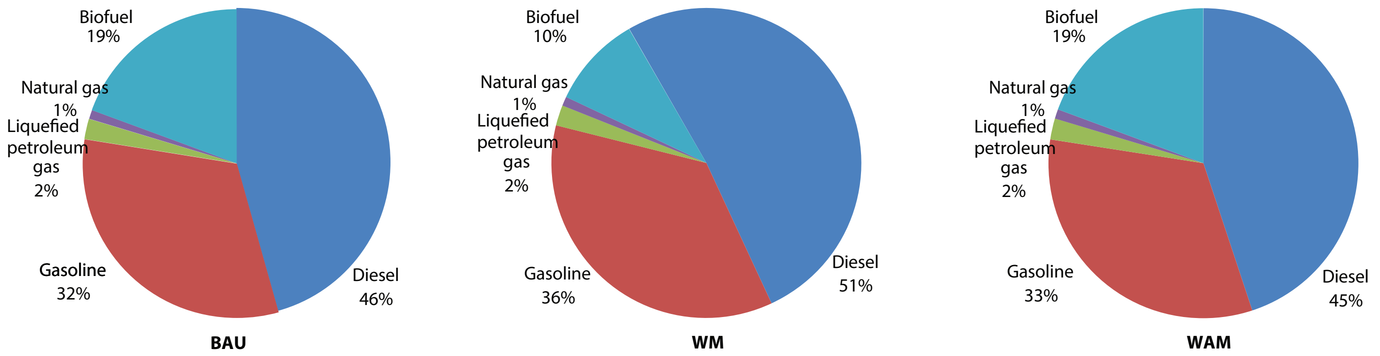


Figure 4-9: Structure of fuel consumption in the transport sector by 2030, % of total.

Thus, in comparison with the year 2010, the BAU scenario shows an increase in the share of diesel fuel by 8.9%, gasoline by 30.6%, and liquefied petroleum gas by 4.9% by the year 2030. The BAU scenario shows that in comparison with the year 2010, by the year 2030 the share of petrol only will grow by 14.2%, whereas other fuels show a decrease in consumption share, including diesel fuel - by 4.5 % and liquefied petroleum gas by 18.5%. Trends under the BAU scenario are also featured under the WM scenario, however, to a greater extent.

II.A.3. Assessment of Mitigation Potential

Tables 4-16 and 4-17 and Figure 4-10 show the dynamics of net GHG emissions from the Transport sector in the Republic of Moldova under the scenarios considered for the period up to 2030.

It should be mentioned that, according to WM scenario, emission levels registered in 2010 will only be achieved by the year 2030 (Table 4-16).

Table 4-16: GHG emissions by gases from fuel combustion in the transport sector of the RM for the period up to 2030, kt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
CO_2	4346.0	1482.1	926.2	1724.0	2037.8	2158.1	1949.7	2163.3	2385.5
CH_4	32.6	10.7	5.9	10.6	11.5	9.9	15.0	16.6	18.2
N_2O	103.1	30.2	16.7	33.4	36.2	35.0	45.3	50.5	56.0
Total	**4481.8**	**1522.9**	**948.8**	**1768.0**	**2085.5**	**2203.0**	**2010.0**	**2230.4**	**2459.7**
WM									
CO_2	4346.0	1482.1	926.2	1724.0	2037.8	2158.1	1778.5	1930.4	2081.4
CH_4	32.6	10.7	5.9	10.6	11.5	9.9	12.2	13.2	14.1
N_2O	103.1	30.2	16.7	33.4	36.2	35.0	36.8	40.4	44.0
Total	**4481.8**	**1522.9**	**948.8**	**1768.0**	**2085.5**	**2203.0**	**1827.5**	**1984.0**	**2139.5**
WAM									
CO_2	4346.0	1482.1	926.2	1724.0	2037.8	2158.1	1547.9	1668.7	1795.5
CH_4	32.6	10.7	5.9	10.6	11.5	9.9	12.1	13.0	13.9
N_2O	103.1	30.2	16.7	33.4	36.2	35.0	36.0	39.4	42.8
Total	**4481.8**	**1522.9**	**948.8**	**1768.0**	**2085.5**	**2203.0**	**1596.0**	**1721.0**	**1852.2**

Compared to the BAU, the WM promises a reduction of GHG emissions from the transport sector by the year 2030 by about 13%, and the WAM, respectively, a decrease by circa 25%. Most of the gas emitted in the Transport sector are of CO_2 type. During 2020-2030 the share of such gases in all scenarios considered is about 97% of all GHG emissions from this sector (Table 4-17).

Table 4-17: The share of different gases in the structure of total direct GHG emissions from Transport sector during the 1990-2030 timeline, %

	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
CO_2	97.0	97.3	97.6	97.5	97.7	98.0	97.0	97.0	97.0
CH_4	0.7	0.7	0.6	0.6	0.6	0.4	0.7	0.7	0.7
N_2O	2.3	2.0	1.8	1.9	1.7	1.6	2.3	2.3	2.3
WM									
CO_2	97.0	97.3	97.6	97.5	97.7	98.0	97.3	97.3	97.3
CH_4	0.7	0.7	0.6	0.6	0.6	0.4	0.7	0.7	0.7
N_2O	2.3	2.0	1.8	1.9	1.7	1.6	2.0	2.0	2.0
WAM									
CO_2	97.0	97.3	97.6	97.5	97.7	98.0	97.0	97.0	96.9
CH_4	0.7	0.7	0.6	0.6	0.6	0.4	0.8	0.8	0.8
N_2O	2.3	2.0	1.8	1.9	1.7	1.6	2.2	2.2	2.3

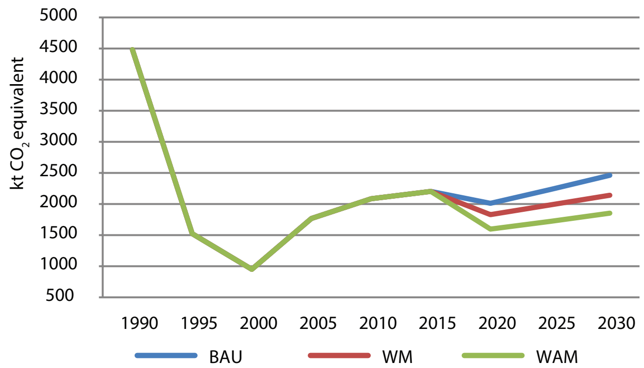


Figure 4-10: Evolution of the GHG emissions from the transport sector of the RM in the period up to 2030.

4.3.2. Industrial Processes and Product Use Sector

The "Industrial Processes and Product Use" (IPPU) sector includes GHG emissions generated directly from the non-energy-related industrial activities. GHG emissions from fossil fuel combustion in Industrial processes are assessed within the energy sector. It should be noted, that according to the assessment report of the Intergovernmental Panel on Climate Change (IPCC, 2007), emissions from non-energy-related industrial activities within the industrial sector vary between 20 and 50% of the total emissions at sector level, the remaining portion being accounted within the energy sector.

In the IPPU sector the most relevant sources emission of direct GHG (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) are clinker production, lime production, use of lime stone and dolomite, use of soda ash, production of bricks, production of glass, production of steel, use of refrigeration and air conditioning equipment, extinguishers, pressurized aerosols, expanded foam products, dielectric substances in electrical equipment, etc.

Projections of the GHG emissions were made on the basis of the methodologic approaches set out in 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) and the EMEP / EEA Air Pollutant Emission Inventory Guidebook (2016).

A. Mitigation Scenarios

Based on the macroeconomic indicators of the Republic of Moldova and the policy documents developed or underway for the industry sector, three scenarios for the period until 2030 were developed and analyzed for the IPPU sector: BAU, WM and WAM scenarios.

BAU – is a reference scenario defining GHG emission levels considered under mitigation policies approved between 01.01.2000-01.01.2010 only. This scenario is developed by considering the evolutionary trends of the industrial sector during the period 2000-2010.

WM – reflects all mitigation policies and measures implemented or adopted after 01.01.2010, with impact assessment until 2030. The evolution of macroeconomic indicators needed to develop this scenario corresponds to projections made by the Ministry of Economy and Infrastructure of the RM (updated in May 2017), and the industrial sector development trends correspond to those recorded during the period 2010-2015. This scenario implies implementation of measures mitigating GHG emissions from this sector, including: use of modern production technologies, accounting of raw materials consumption and efficient management, use of effective management systems and reducing production losses and use of recycled raw materials, upgrading of technological processes as a result of implementation of a number of energy efficiency and clean production projects financed externally. Measures provided for under the WM scenario correspond to the measures provided for in the Low Emissions Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation, published in March 2017.

WAM – represents the policies and mitigation measures planned to be adopted in the period until 2030. The measures provided for under the WM scenario correspond to the measures stipulated in the Low Emissions Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation, published in March 2017, and require donor support. The evolution of macroeconomic indicators needed for drafting this scenario was determined on the basis of projections made by the Ministry of Economy and Infrastructure of the RM (updated in May 2017).

B. Projections on Industrial Production

The industrial production prospects for the IPPU sector have been developed for the categories 2A "Mineral industry", 2C "Metal industry", 2D "Non-energy products from fuels and solvent use", 2F "Product uses as ODS substitutes" and 2G "Other product manufacture and use". According to the National Inventory Report of RM[170], in 2015 the category 2A accounted for 64.2% of the GHG emissions from the IPPU sector, 2C – 2.2%, 2D – 10.9%, 2F – 22.6% and 2G – 0.1%.

Starting from the contribution of the categories nominated above to the total amount of GHG emissions from this sector, we will further focus on projections for industrial production in categories 2A and 2F, which taken together account for 86.8% of the GHG emissions in the IPPU sector. For other categories, 2C, 2D, 2G, the projections have been made, but not yet revealed, the results being taken into account only for calculation of total GHG emissions by sector.

The projections for industrial production in the source category 2A "Mineral industry" is presented in Table 4-12 and were developed for:

BAU: based on statistical data for the period 2000-2010, by extrapolating until 2030. For the cement and clinker production extrapolation has been carried out on the basis of the GDP growth forecast for the baseline scenario and cement production growth rate in 2011-2015. Ultimately, an annual growth rate of 4.5% was adopted, based on macroeconomic growth of the industry sector. This source category generates about 65% of all GHG emissions of the IPPU sector.

WM: the projections were drawn up on the basis of statistical data for 2011-2015, consideration of measures already adopted and underway, as well as the macroeconomic indicators of the industrial sector.

WAM: the statistical data for 2011-2015, measures adopted so far and measures planned to be adopted in the medium term, as well as macroeconomic indicators of the sector were used. These data were used as a basis for extrapolation of data until 2030.

The results obtained show that cement production will reach 95% of the level of 1990, and clinker production will reach 97.7% by the year 2030. Production of cement under the WM scenario compared to BAU towards the year 2030 will increase by 15.3%, while clinker production will decrease by 38.0%. Under the WAM, however, cement production by the year 2030 will increase by 23.8 % compared to BAU, and clinker production will decrease by 45.0%.

The same approaches were used for projections for the source category 2C "Metal industry", 2D "Non-energy products from fuels and solvent use", and 2G "Other product manufacture and use". The most important values of these industrial activities are the following: under the BAU, by the year 2030 steel production will reach 49%, laminates - 42.6%, lubricants - 32.2%, concrete asphalt - 54.4% of the level of 1990. Under the WM scenario, respectively, steel - 205% compared to BAU, laminates - 156%, lubricants - 78%, concrete asphalt -18%, and under the WAM, production of steel - 319%, laminates - 243%, lubricants - 68%, concrete asphalt - 27%.

2F "Product uses as ODS substitutes" category, the most important sources of emissions of F-gases in the Republic of Moldova are refrigeration equipment (refrigerators, freezers, refrigeration glass cases), as well as stationary and car air conditioning. Moldova does not produce HFC, PFC and SF_6. GHG emissions mitigation measures for category 2F are geared mainly towards the gradual substitution of freezer with less pollutant substitutes.

The projections of fluorinated gases imports, on stock and those incorporated into equipment in the RM, for all three scenarios are listed in Table 4-18.

[170] National Inventory Report: 1990-2015, Greenhouse Gas Sources and Sinks in the Republic of Moldova to UNFCC (2017).

Table 4-18: Import of fluorinated gases (on stock and incorporated in equipment and products) in the RM during 1995-2030

	1995	2000	2005	2010	2015	2020	2025	2030
BAU								
HFC-32, t	0.1	0.5	6.8	35.0	75.3	86.6	99.5	114.5
HFC-125, t	0.2	0.9	9.4	46.4	118.1	142.0	167.2	199.0
HFC-134a, t	31.0	137.4	408.2	903.0	1244.4	1344.0	1478.3	1500.5
HFC-143a, t	0.1	0.4	2.5	14.1	47.3	55.7	63.3	73.6
CF_4, t	NO	NO	NO	0.2	0.2	0.2	0.2	0.2
SF_6, t	NO	NO	0.1	1.2	1.4	1.7	1.9	2.1
WM								
HFC-32, t	0.1	0.5	6.8	35.0	75.3	84.0	96.5	111.0
HFC-125, t	0.2	0.9	9.4	46.4	118.1	139.1	163.9	195.1
HFC-134a, t	31.0	137.4	408.2	903.0	1244.4	1142.4	1256.6	1275.4
HFC-143a, t	0.1	0.4	2.5	14.1	47.3	54.0	61.4	71.4
CF_4, t	NO	NO	NO	0.2	0.2	0.3	0.3	0.3
SF_6, t	NO	NO	0.1	1.2	1.4	1.8	2.1	2.4
WAM								
HFC-32, t	0.1	0.5	6.8	35.0	75.3	81.4	93.6	107.6
HFC-125, t	0.2	0.9	9.4	46.4	118.1	136.3	160.5	191.1
HFC-134a, t	31.0	137.4	408.2	903.0	1244.4	1008.0	1108.8	1125.4
HFC-143a, t	0.1	0.4	2.5	14.1	47.3	51.2	58.2	67.7
CF_4, t	NO	NO	NO	0.2	0.2	0.3	0.3	0.3
SF_6, t	NO	NO	0.1	1.2	1.4	1.9	2.1	2.3

Table 4-19: Projections of industrial products from the source category 2A "Mineral industry" in the Republic of Moldova during 1990-2030

Categories	1990	2010	2015	2020		
	Real, according to the national GHG inventory			BAU	WM	WAM
Cement production, thousand tons	2288.00	861.40	1122.80	1399.21	1467.45	1502.56
Clinker production, 1 000 tons	1801.30	655.60	830.90	1133.36	947.16	902.93
Lime production, kt	204.30	3.18	8.18	8.97	8.86	10.27
Import of lime in the RM, kt	0.00	4.83	4.66	10.70	4.86	5.63
Lime with high content of calcium, kt	266.26	24.80	24.91	16.33	42.97	49.81
Dolomitic lime, kt	46.99	4.38	4.40	2.70	7.58	8.79
Commercially produced lime, kt	204.30	3.37	8.18	5.94	8.87	10.28
Lime produced by local producers, kt	108.95	25.8	21.13	12.09	41.68	48.32
Granulated sugar produced from sugar beets, kt	0.00	103.21	84.52	48.36	166.73	193.29
Amount of lime used for sugar production, kt	0.00	25.80	21.13	11.89	41.68	48.32
Sterilized glass jars, kt	164.40	24.95	57.28	6.85	105.77	122.62
Glass bottles and containers, kt	71.17	105.87	98.45	111.98	71.44	82.81
Glass produced in the RM, kt	235.57	136.62	163.97	132.94	189.09	219.21
Total bricks production, kt	769.20	159.90	152.99	216.19	146.66	170.02
Clay used to produce bricks, kt	846.12	175.89	168.28	237.81	161.33	187.03
Production of expanded clay, mii m^3	0.00	61.42	22.98	145.37	22.60	26.20
Production expanded clay, kt	0.00	21.70	9.16	52.75	10.13	11.74
Clay used in production of expanded clay, kt	0.00	35.13	15.63	62.80	15.53	18.01
Soda ash consumption, kt	67.87	29.03	26.34	26.56	25.35	29.38
Average annual consumption of soda ash, kt	65.76	28.32	33.99	22.98	38.16	44.24
Amount of soda ash used in glass industry, kt	59.39	25.57	30.70	20.75	34.46	39.95
Amount of soda ash used in other applications, kt	6.38	2.75	3.30	2.23	3.70	4.29
Categories	**2025**			**2030**		
	BAU	**WM**	**WAM**	**BAU**	**WM**	**WAM**
Cement production, thousand tons	1743.67	1917.9	2010.76	2172.94	2506.62	2690.86
Clinker production, 1 000 tons	1412.38	1014.81	934.38	1760.08	1082.47	965.84
Lime production, kt	9.79	10.13	13.61	10.61	11.43	17.81
Import of lime in the RM, kt	13.12	4.92	6.61	15.54	4.98	7.76
Lime with high content of calcium, kt	10.53	53.23	71.53	4.74	63.49	98.91
Dolomitic lime, kt	1.68	9.39	12.62	0.66	11.2	17.46
Commercially produced lime, kt	5.00	10.14	13.62	4.05	11.41	17.77
Lime produced by local producers, kt	6.22	52.49	70.54	0.34	63.29	98.60
Granulated sugar produced from sugar beets, kt	24.87	209.94	282.14	1.37	253.15	394.4
Amount of lime used for sugar production, kt	6.02	52.49	70.54	0.15	63.29	98.6
Sterilized glass jars, kt	0.00	166.04	223.14	0.00	226.3	352.57
Glass bottles and containers, kt	108.91	34.02	45.72	105.83	0.00	0.00
Glass produced in the RM, kt	127.89	215.25	289.28	129.7	244.98	381.67
Total bricks production, kt	218.47	135.64	182.29	220.75	124.61	194.14
Clay used to produce bricks, kt	240.32	149.2	200.51	242.83	137.07	213.56

Categories	2025			2030		
	BAU	WM	WAM	BAU	WM	WAM
Production of expanded clay, mii m^3	180.97	13.43	18.05	216.58	4.25	6.62
Production expanded clay, kt	64.22	6.82	9.17	75.13	2.42	3.76
Clay used in production of expanded clay, kt	62.43	9.55	12.83	55.88	3.13	4.87
Soda ash consumption, kt	23.87	20.28	27.25	21.18	15.21	23.7
Average annual consumption of soda ash, kt	19.32	43.57	58.56	15.66	48.98	76.31
Amount of soda ash used in glass industry, kt	17.45	39.35	52.88	14.14	44.23	68.91
Amount of soda ash used in other applications, kt	1.87	4.23	5.68	1.52	4.75	7.40

The activity data in industrial sector were generated on the basis of: the macroeconomic indicators determined on the basis of the Ministry of Economy forecasts; extrapolation of statistical data on imports of fluorinated gases in the Republic of Moldova, both in stock and in the preloaded air conditioning systems for rooms and cars; in refrigerators, freezers, refrigeration showcases, and coolers; in mono-component foam products; in aerosols for medical purposes; as well as in the high-voltage electrical switchgear during the period 1995-2015, taking into account the trends of those years; also based on the sustainable development policies of the refrigeration sector, developed in view of subsequent transposition of the EC Regulation 842/2006 of 17 May 2006 on certain fluorinated gases.

The most important developments in industrial production are presented in Table 4-19. It is worth mentioning, that while calculating the emissions the whole range of products having an impact on GHG emissions have been taken into consideration.

C. Assessment of Mitigation Potential

Calculation methodologies and default emission factors available in the IPCC 2006 Guidelines for National GHG Emission Inventories and the EMEP/EEA Air Pollutant Emission Inventory Guidebook were used for the GHG emissions calculation (2016).

GHG emissions projections for the period 2016-2030 were estimated for three scenarios - BAU, WM and WAM, using the appropriate criteria for each scenario.

Below are the calculation results for direct GHG emissions from the IPPU sector, by types of gases (Table 4-20) and emissions sources (Table 4-21).

Table 4-20: Direct GHG emissions from IPPU sector, by gas, for 1990-2030, kt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
CO_2	1581.0	448.9	308.6	556.3	490.8	613.7	835.1	1027.6	1258.6
CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O	0.02	0.00	0.01	0.02	NO	NO	NO	NO	NO
HFCs	NO	4.6	10.5	42.2	113.4	179.4	312.0	416.0	572.0
PFCs	NO	NO	NO	NO	0.0	0.0	0.2	0.2	0.3
SF_6	NO	NO	NO	0,1	0.7	1.1	0.8	1	1.2
Total	**1581.0**	**453.5**	**319.0**	**598.6**	**604.9**	**794.2**	**1147.9**	**1444.6**	**1831.8**
WM									
CO_2	1581.0	448.9	308.6	556.3	490.8	613.7	734.1	838.4	942.7
CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O	0.0	0.0	0.0	0.0	NO	NO	NO	NO	NO
HFCs	NO	4.6	10.5	42.2	113.4	179.4	301.1	397.3	514.8
PFCs	NO	NO	NO	NO	0.0	0.0	0.2	0.2	0.2
SF_6	NO	NO	NO	0.1	0.7	1.1	0.9	1.2	1.4
Total	**1581.0**	**453.5**	**319.0**	**598.6**	**604.9**	**794.2**	**1036.1**	**1236.9**	**1458.9**
WAM									
CO_2	1581.0	448.9	308.6	556.3	490.8	509.7	575.1	621.4	667.8
CH_4	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O	0.0	0.0	0.0	0.0	NO	NO	NO	NO	NO
HFCs	NO	4.6	10.5	42.2	113.4	179.4	271.0	349.6	442.7
PFCs	NO	NO	NO	NO	0.0	0.0	0.2	0.2	0.2
SF_6	NO	NO	NO	0.1	0.7	1.1	0.9	1.3	1.4
Total	**1581.0**	**453.5**	**319.0**	**598.6**	**604.9**	**690.2**	**847.0**	**972.3**	**1111.9**

Table 4-21: Direct GHG emissions from IPPU sector, by emission sources, for 1990-2030, kt CO_2 equivalent

Categories of sources	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
2A. Mineral industry	1316.1	345.1	240.0	444.8	412.7	509.7	635.2	791.5	986.4
2C. Metal industry	28.5	26.2	36.3	42.0	9.7	17.2	38.9	40.3	41.6
2D. Non-energy products from fuels and solvent use	233.2	76.5	31.4	68.5	67.5	86.8	161.0	195.8	230.6
2F. Product uses as ODS substitutes	0.0	4.6	10.5	42.2	113.4	179.4	313.0	417.2	573.5
2G. Other product manufacture and use	3.2	1.1	0.9	1.1	0.9	0.8	0.8	0.8	0.8
Total	**1581.0**	**453.5**	**319.1**	**598.5**	**604.2**	**794.0**	**1148.9**	**1445.6**	**1832.8**

Categories of sources	1990	1995	2000	2005	2010	2015	2020	2025	2030
			WM						
2A. Mineral industry	1316.1	345.1	240.0	444.8	412.7	509.7	602.3	673.7	745.1
2C. Metal industry	28.5	26.2	36.3	42.0	9.7	17.2	19.4	24.8	30.2
2D. Non-energy products from fuels and solvent use	233.2	76.5	31.4	68.5	67.5	86.8	112.4	139.9	167.3
2F. Product uses as ODS substitutes	0.0	4.6	10.5	42.2	113.4	179.4	302.2	398.7	516.4
2G. Other product manufacture and use	3.2	1.1	0.9	1.1	0.9	0.8	0.9	0.8	0.8
Total	**1581.0**	**453.5**	**319.1**	**598.5**	**604.2**	**794.0**	**1037.2**	**1237.8**	**1459.9**
			WAM						
2A. Mineral industry	1316.1	345.1	240.0	444.8	412.7	509.7	575.1	621.4	667.8
2C. Metal industry	28.5	26.2	36.3	42.0	9.7	17.2	17.8	22.0	26.1
2D. Non-energy products from fuels and solvent use	233.2	76.5	31.4	68.5	67.5	86.8	103.9	124.3	144.8
2F. Product uses as ODS substitutes	0.0	4.6	10.5	42.2	113.4	179.4	272.1	351.1	444.3
2G. Other product manufacture and use	3.2	1.1	0.9	1.1	0.9	0.8	0.8	0.8	0.8
Total	**1581.0**	**453.5**	**319.1**	**598.5**	**604.2**	**794.0**	**969.7**	**1119.7**	**1283.8**

Below is the dynamics of direct GHG emissions from the IPPU sector under the mitigation scenarios considered for the period 1990-2030. Compared to 1990 baseline, by 2030, it is expected that direct GHG emissions from this sector will increase by 15.9% under the BAU scenario, decrease by 7.7% under the WM scenario, and decrease by 18.8% under the WAM scenario. Dynamics direct GHG emissions from the IPPU sector for 1990-2030 in the RM is shown in Figure 4-11.

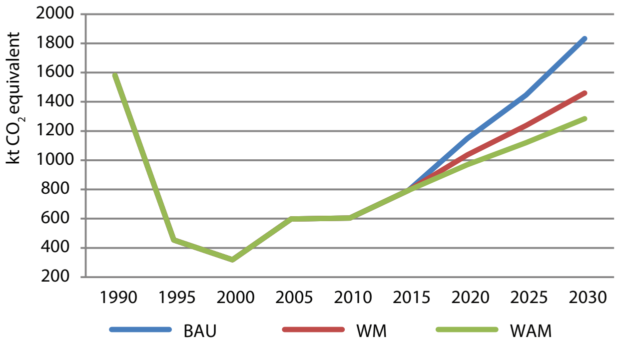


Figure 4-11: Dynamics direct GHG emissions from the IPPU sector for 1990-2030.

The evolution of industrial production, consumption of HFC and implementation of mitigation measures will influence the redistribution of the share of different gases, as well as different source categories in the structure of total direct GHG from the IPPU sector (Tables 4-22 and 4-23).

Table 4-22: Share of different gases in total direct GHG emissions from the IPPU sector within 1990-2030, %

	1990	1995	2000	2005	2010	2015	2020	2025	2030
				BAU					
CO_2	100.0	99.0	96.7	92.9	81.1	77.3	72.8	71.1	68.7
CH_4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N_2O	0.0	0.0	0.0	0.0	NA	NA	NA	NA	NA
HFCs	NA	1.0	3.3	7.0	18.8	22.6	27.2	28.8	31.2
PFCs	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
SF_6	NA	NA	NA	0.0	0.1	0.1	0.1	0.1	0.1
				WM					
CO_2	100.0	99.0	96.7	92.9	81.1	77.3	70.9	67.8	64.6
CH_4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N_2O	0.0	0.0	0.0	0.0	NA	NA	NA	NA	NA
HFCs	NA	1.0	3.3	7.0	18.8	22.6	29.1	32.1	35.3
PFCs	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
SF_6	NA	NA	NA	0.0	0.1	0.1	0.1	0.1	0.1
				WAM					
CO_2	100.0	99.0	96.7	92.9	81.1	73.8	67.9	63.9	60.1
CH_4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N_2O	0.00	0.00	0.00	0.00	NA	NA	NA	NA	NA
HFCs	NA	1.0	3.3	7.0	18.8	26.0	32.0	36.0	39.8
PFCs	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
SF_6	NA	NA	NA	0.0	0.1	0.2	0.1	0.1	0.1

In comparison with the baseline scenario, mitigation scenarios envisage an increase in the share of the 2F "Product uses as ODS substitutes" category, while the 2A "Mineral industry" category shows a decreasing trend.

Table 4-23: Share of different sources in the structure of total direct GHG emissions from IPPU sector in 1990-2030, %

Source Categories	1990	1995	2000	2005	2010	2015	2020	2025	2030
			BAU						
2A. Mineral industry	83.2	76.1	75.2	74.3	68.3	64.2	55.3	54.8	53.8
2C. Metal industry	1.8	5.8	11.4	7.0	1.6	2.2	3.4	2.8.	2.3
2D. Non-energy products from fuels and solvent use	14.8	16.9	9.8	11.4	11.2	10.9	14.0	13.5	12.6
2F. Product uses as ODS substitutes	0.0	1.0	3.3	7.0	18.8	22.6.	27.2	28.9	31.3
2G. Other product manufacture and use	0.2	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.0
			WM						
2A. Mineral industry	83.2	76.1	75.2	74.3	68.3	64.2	58.1	54.4	51.0
2C. Metal industry	1.8	5.8	11.4	7.0	1.6	2.2	1.9	2.0	2.1
2D. Non-energy products from fuels and solvent use	14.8	16.9	9.8	11.4	11.2	10.9	10.8	11.3	11.5
2F. Product uses as ODS substitutes	0.0	1.0	3.3	7.0	18.8	22.6	29.10	32.2	35.4
2G. Other product manufacture and use	0.2	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.1
			WAM						
2A. Mineral industry	83.2	76.1	75.2	74.3	68.3	64.2	59.3	55.5	52.0
2C. Metal industry	1.8	5.8	11.4	7.0	1.6	2.2	1.8	2.0	2.0
2D. Non-energy products from fuels and solvent use	14.8	16.9	9.8	11.4	11.2	10.9	10.7	11.1	11.3
2F. Product uses as ODS substitutes	0.0	1.0	3.3	7.0	18.8	22.6	28.1	31.4	34.6
2G. Other product manufacture and use	0.2	0.2	0.3	0.2	0.1	0.1	0.1	0.1	0.1

4.3.3. Agricultural Sector

The emissions monitored in the agricultural sector are methane emissions from animal husbandry, in particular emissions from the source categories 3A "Enteric fermentation" and 3B "Manure management", and nitrous oxide emissions from the source categories 3B "Manure management" and 3D "Agricultural soils". The 3H "Urea application" source category is also a source of CO_2 emissions, but in smaller amounts which are projected to be 5.8 kt CO_2 / year until 2030, the same as in 2015, according to the "National Inventory Report: 1990-2015, GHG Sources and Sinks in the Republic of Moldova".

Whereas in the RM rice is not cultivated and there are no savannahs, there are no GHG emissions from rice cultivation and burning of savannahs. Also, CO_2 emissions / removals from agricultural soils, according to the 2006 IPCC Guidelines, were considered in the LULUCF sector. Projections for direct GHG emissions from the agricultural sector were made on the basis of methodological approaches set out in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

A. Mitigation Scenarios

Three scenarios for the agricultural sector development until 2030 were developed and considered the basis of Moldova's macroeconomic indicators.

BAU – considers the mitigation policies of the country approved prior to 01.01.2000-01.01.2010. The strategic policy documents of the Republic of Moldova in the agricultural sector taken into consideration for developing the BAU scenario are: Agricultural and Food Industry Development Strategy for 2006-2015 (approved by the GD no. 1199 of 17.10.2006), the National Development Strategy for 2008-2011 (approved by Law no. 295-XVI of 21.12.2007) and the National Strategy of sustainable development of Agribusiness of the Republic of Moldova for 2008-2015 (approved by the GD no. 282 of 11.03.2008). The BAU scenario is an option providing for a level of the agricultural technologies progress, amount of chemical and organic fertilizers used, improvement of the structure of agricultural crops that will lead to some increase in the amount of agricultural production and organic waste returned to the soil. The evolving macroeconomic indicators were determined on the basis of forecasts made by the Ministry of Economy and Infrastructure of the RM in May 2017.

WM – reflects the policies and measures implemented or adopted since 1 January 2010 until the end of 2015, with the implementation period up to 2030, including: the Soil Conservation and Fertility Enhancement Program for 2011-2020 and the Action Plan for the Implementation of the soil Conservation and Fertility Enhancement Program for 2011-2013, the National Complex Soil Fertility Enhancement Program for 2001-2020, the National Development Strategy "Moldova 2020", the National Strategy for Agricultural and Rural Development for 2014-2020. All these documents have been focused in particular on optimizing the application of mineral and organic fertilizers, incorporation of plant residues in the soil, use of green fertilizers and more extensive introduction of conservative agriculture. For the animal husbandry sector the focus was on breeding and gradual replacement of the currently used breeds of livestock and poultry with breeds of higher productive indicators, and use of sustainable manure management systems.

WAM – covers the policies and measures developed since 1 January 2016, but not adopted by the end of 2016, planned for approval and implementation during 2017-2030, such as the Action Plan for the implementation of the Soil Conservation and Fertility Enhancement Program for 2017-2020, as well as other policy documents pending in Parliament. The WAM provides for implementation of the same set of GHG emissions mitigation measures as the WM, but to a larger extent, as well as making use of the best practices and the most advanced measures ensuring sustainable development of the agricultural sector.

B. Projections of Economic Indicators

The projections for the agricultural sector economic indicators (animal husbandry and plant cultivation) having direct impact on GHG emissions, developed in accordance with the policies set out above, including in Chapter 3, used in the three developed scenarios, are set out below.

Table 4-24 contains the projections related to sown areas, including application of green fertilizers and conservative agriculture system for 1990-2030. Table 4-25 contains the projections related to domestic animals and poultry until 2030, whereas Tables 4-26, 4-27 and 4-28 show the projections for factors that lead to the increase of organic matter flow in the soil and long-term preservation of their fertility, thus resulting in reduction of direct GHG emissions.

With regard to green fertilizers (autumn vetch as intermediate crop), the following basic parameters were taken into consideration: the average humidity of the green mass - 80%; average nitrogen content in the green mass - 0.8%; average productivity - 20 t/ha; manure with bedding transformation factor of 1.4 (1 ton of green mass of vetch equivalent to 1.4 tons of cattle manure with bedding in terms of the amount of nitrogen contained)[171]. Using intermediate crops as green fertilizer shall be done in parallel with the implementation of the no-till and mini-till soil cultivation technologies used in conservative agriculture.

Under the conservative agriculture system all residues from the main crop shall be left in the field for mulching. The area where conservative agriculture is planned to be implemented is expected to be twice the area used for growing intermediary crops, because intermediary crops are sown after the autumn grain crops (wheat and winter barley), and in the second year, after the incorporation of vetch into the soil as a green fertilizer, these areas shall be used again in the conservative agriculture system, this time for the hoeing crops (sunflower, and maize).

Table 4-27 presents the projections of values of additional factors that lead to the increase of the organic matter flow in cultivated agricultural soils and contribute to a long-term preservation of their fertility (F_{PRP} - amounts of nitrogen incorporated in the soil with urine and animal manure in the grazing process, respectively F_{CR} - nitrogen incorporated into the soil with agricultural residues). F_{PRP} index was calculated on the basis of the information associated with the source categories 3A "Enteric fermentation" and 3B "Manure

[171] Cerbari, V., Scorpan, V., Taranu, M., Bacean, I. (2012), Remedy of the quality and the productivity capacity of States common chernozems in the south of Moldova as influenced by some actions, phytotechnology Environment (Environment), the Scientific Journal of Ecological Information and Culture, no. 1 (61), February 2012, p. 38-43

management", according to Tier I calculation methodology (2006 IPCC Guidelines).

Regarding F_{CR}, it was calculated based on projections for agricultural areas sown with crops during for 1990-2030 timeline (Table 4-24), and information on projections of average yield of the main crops per hectare during 1990-2030.

Change of land use and soil management practices can significantly influence the reserves of organic carbon in the soil. The content of organic matter in the soil (humus) depends closely on the contents of organic carbon and nitrogen. Carbon losses through the process of mineralization, as a result of changes in agricultural land use and soil management practices, are accompanied by the simultaneous biochemical decomposition of nitrogen from humus. In case of soil carbon losses, mineralized nitrogen is considered to be an additional source of nitrogen which can release N_2O emissions (2006 IPCC Guidelines). Table 4-28 presents the projections for the total amount of mineralized nitrogen (F_{SOM}) related to the carbon losses from agricultural soils of the Republic of Moldova for the period until 2030. To estimate these amounts, the Methodology for calculating the carbon balance in arable lands, in view of assessing the GHG emissions, was used[172].

[172] Banaru, Anatol (2000), *Methodology for calculation of GHG emissions from arable soils.* Collection "Climate change. Research, studies, solutions ". Ministry of Environment and spatial planning/UNDP Moldova. "Bons Offices" S.R.L. Chisinau, 2000. P. 115-123.

Table 4-24: Projections for sown areas, including with application of green fertilizer and conservative agriculture system during 1990-2030

Indicators	1990	2010	2015	2020	2025	2030
BAU						
Sown areas, thousand ha, including:	1734.0	1598.5	1660.3	1671.7	1635.5	1636.8
Areas on which green fertilizers – vetch will be applied, thousand ha	NO	NO	NO	25.0	50.0	75.0
Areas on which conservative agriculture will be practiced, thousand ha	NO	NO	NO	50.0	100.0	200.0
WM						
Sown areas, thousand ha, including:	1734.0	1725.5	1660.3	1637.0	1631.2	1627.6
Areas on which green fertilizers - vetch will be applied, thousand ha	NO	NO	NO	50.0	125.0	175.0
Areas on which conservative agriculture will be practiced, thousand ha	NO	NO	NO	100.0	200.0	300.0
WAM						
Sown areas, thousand ha, including:	1734.0	1598.5	1660.3	1634.2	1628.3	1624.3
Areas on which green fertilizers - vetch will be applied, thousand ha	NO	NO	NO	75.0	150.0	200.0
Areas on which conservative agriculture will be practiced, thousand ha	NO	NO	NO	200.0	300.0	400.0

Table 4-25: Projections for numbers of livestock during 1990-2030, thousand heads

Animal	1990	2010	2015	2020	2025	2030
	BAU					
Total cattle	1 061	236	204	218	227	236
Dairy cows	395	166	138	146	151	156
Other cattle	665	70	66	72	76	80
Sheep	1 245	801	729	740	745	750
Goats	37	119	152	180	190	200
Horses	47	54	40	38	38	38
Assess and mules	2	3	2	2	2	2
Swine	1 850	512	484	525	565	600
Rabbits	283	277	350	400	450	500
Poultry	24 625	23 117	11 913	16 000	21 000	26 000
	WM					
Total cattle	1 061	236	204	212	220	226
Dairy cows	395	166	138	142	146	150
Other cattle	665	70	66	70	74	76
Sheep	1 245	801	729	735	740	745
Goats	37	119	152	170	180	190
Horses	47	54	40	35	35	35
Assess and mules	2	3	2	2	2	2
Swine	1 850	512	484	515	545	575
Rabbits	283	277	350	390	420	450
Poultry	24 625	23 117	11 913	15 000	18 000	23 000
	WAM					
Total cattle	1 061	236	204	208	214	220
Dairy cows	395	166	138	140	142	146
Other cattle	665	70	66	68	72	74
Sheep	1 245	801	729	730	735	740
Goats	37	119	152	160	170	180
Horses	47	54	40	35	32	30
Assess and mules	2	3	2	2	2	2
Swine	1 850	512	484	505	525	550
Rabbits	283	277	350	380	440	460
Poultry	24 625	23 117	11 913	14 000	16 000	19 000

Table 4-26: Projections on use of chemical nitrogen and natural organic fertilizers in the RM during 1990-2030, kt N

Indicators	1990	1995	2000	2005	2010	2015	2020	2025	2030
	BAU								
Chemical nitrogen fertilizer, F_{SN}	92.1	10.5	10.2	16.1	20.6	38.7	50.0	60.0	70.0
Natural organic fertilizer, F_{ON}	55.5	34.0	21.4	21.1	18.7	15.1	22.1	28.2	34.6
	WM								
Chemical nitrogen fertilizer, F_{SN}	92.1	10.5	10.2	16.1	20.6	38.7	60.0	70.0	80.0
Natural organic fertilizer, F_{ON}	55.5	34.0	21.4	21.1	18.7	15.9	25.5	31.7	38.3
	WAM								
Chemical nitrogen fertilizer, F_{SN}	92.1	10.5	10.2	16.1	20.6	38.7	70.0	80.0	90.0
Natural organic fertilizer, F_{ON}	55.5	34.0	21.4	21.1	18.7	15.9	29.10	35.6	45.3

Table 4-27: Projections on amounts of nitrogen incorporated in soil with urine and manure during grazing, and those returned in the soil with agricultural residues in the RM during 2005-2030, kt N

Indicators	1990	1995	2000	2005	2010	2015	2020	2025	2030
	BAU								
Urine and manure, F_{PRP}	7.57	11.59	9.36	8.75	7.71	7.05	7.34	7.54	7.35
Agricultural residues, F_{CR}	34.81	21.64	16.03	20.05	21.28	18.99	22.87	26.74	32.17
	WM								
Urine and manure, F_{PRP}	7.57	11.59	9.36	8.75	7.71	7.05	6.88	6.86	6.47
Agricultural residues, F_{CR}	34.81	21.64	16.03	20.05	21.28	18.99	26.29	32.48	38.95
	WAM								
Urine and manure, F_{PRP}	7.57	11.59	9.36	8.75	7.71	7.05	6.43	6.39	5.73
Agricultural residues, F_{CR}	34.81	21.64	16.03	20.05	21.28	18.99	30.37	39.33	44.98

Table 4-28: Projections on the amount of mineralized nitrogen due to carbon losses resulting from change of agricultural land use and the soil management practices during 2005 - 2030, kt N

Indicators	1990	1995	2000	2005	2010	2015	2020	2025	2030
	BAU								
Mineralized nitrogen resulted from carbon losses F_{SOM}	34.45	89.66	82.87	114.38	102.96	89.52	101.70	88.68	80.51
	WM								
Mineralized nitrogen resulted from carbon losses F_{SOM}	34.45	89.66	82.87	114.38	102.96	89.52	98.06	81.40	70.05
	WAM								
Mineralized nitrogen resulted from carbon losses F_{SOM}	34.45	89.66	82.87	114.38	102.96	89.52	92.94	71.17	56.48

The higher productivity growth rates under the WM and WAM scenarios will contribute to the increase in emission factor values, calculated according to Tier 1 calculation methodology (2006 IPCC Guidelines), used to calculate CH_4 emissions from 3A "Enteric fermentation". According to WAM scenario, it is expected that the productivity level in the animal husbandry sector in Moldova will be similar to the currently existent in Western European countries, i.e. emission factors will have values close to the default values of emission factors used for calculation of CH_4 emissions in the 3A "Enteric fermentation", specific for Western European countries (117 kg CH_4 / capita / year - for dairy cows, 57 kg CH_4 / capita / year - for other cattle, 8 kg CH_4 / capita / year - for sheep, 5 kg CH_4 / capita / year - for goats, 18 kg CH_4 / capita / year - equines, 10 kg CH_4 / capita / year - for asinine, 1.5 kg CH_4 / capita / - for rabbits).

As a result of discrepancies between the actual manure management systems used in the RM and those described in the 2006 IPCC Guidelines (with reference to Eastern European countries), it was not considered appropriate to apply the default coefficients with reference to the share of various manure management systems characteristic of the Eastern European countries. Thus, for calculation of CH_4 emissions from the source category 3B "Manure management" (for cattle and swine), national values were used, resulting from a study carried out in May - June 2015 by the Institute of Scientific and Practical Biotechnologies in Animal Husbandry and Veterinary Medicine and the National Food Safety Agency.

C. Assessment of Mitigation Potential

The evaluation methodologies (including emission factors) were taken from the 2006 IPCC Guideline for inventory of national GHG emissions, using the results of the economic calculations based on the evolution of economic indicators in the agricultural sector during the period 2005-2030 in the scenarios analyzed. Estimation methodologies and national emission-specific emission factors were also used, applying data of activity, key indicators and assumptions set out above. The calculation results for direct GHG emissions from agriculture sector, both by types of gas (Table 4-29 and Table 4-30), and by emission sources (Table 4-31) are presented below.

Table 4-29: Aggregated direct GHG emissions from the agricultural sector under the scenarios considered for 1990-2030, kt CO_2 equivalent

	1990	2010	2015	2020	2025	2030
BAU						
Total emissions CH_4, including:	**2685.5**	**789.0**	**725.0**	**852.2**	**886.1**	**919.2**
enteric fermentation	2190.7	712.6	654.6	743.3	768.2	792.8
manure management	494.8	76.4	70.4	108.9	117.9	126.4
Total N_2O emissions, including:	**2524.5**	**1459.0**	**1383.9**	**1642.3**	**1749.1**	**1894.3**
manure management	1116.6	422.1	352.1	404.3	457.9	515.3
agricultural soils	1407.8	1036.9	1031.8	1238.0	1291.2	1379.0
Total direct GHG emissions, including:	**5210.0**	**2248.0**	**2108.9**	**2494.5**	**2635.2**	**2813.5**
enteric fermentation	2190.7	712.6	654.6	743.3	768.2	792.8
manure management	1611.4	498.5	422.4	513.2	575.8	641.7
agricultural soils	1407.8	1036.9	1031.8	1238.0	1291.2	1379.0
WM						
Total emissions CH_4, including:	**2685.5**	**789.0**	**725.0**	**830.5**	**858.1**	**884.0**
enteric fermentation	2190.7	712.6	654.6	724.7	745.9	764.3
manure management	494.8	76.4	70.4	105.8	112.2	119.7
Total N_2O emissions, including:	**2524.5**	**1459.0**	**1383.9**	**1710.0**	**1809.6**	**1945.3**
manure management	1116.6	422.1	352.1	392.3	448.1	509.2
agricultural soils	1407.8	1036.9	1031.8	1317.7	1361.5	1436.1
Total direct GHG emissions, including:	**5210.0**	**2248.0**	**2108.9**	**2540.5**	**2667.7**	**2829.3**
enteric fermentation	2190.7	712.6	654.6	724.7	745.9	764.3
manure management	1611.4	498.5	422.4	498.1	560.3	628.9
agricultural soils	1407.8	1036.9	1031.8	1317.7	1361.5	1436.1
WAM						
Total emissions CH_4, including:	**2685.5**	**789.0**	**725.0**	**816.6**	**834.9**	**857.6**
enteric fermentation	2190.7	712.6	654.6	713.2	727.3	744.4
manure management	494.8	76.4	70.4	103.4	107.6	113.2
Total N_2O emissions, including:	**2524.5**	**1459.0**	**1383.9**	**1776.6**	**1871.5**	**1977.9**
manure management	1116.6	422.1	352.1	383.2	445.9	483.5
agricultural soils	1407.8	1036.9	1031.8	1393.4	1425.6	1494.4
Total direct GHG emissions, including:	**5210.0**	**2248.0**	**2108.9**	**2593.2**	**2706.4**	**2835.5**
enteric fermentation	2190.7	712.6	654.6	713.2	727.3	744.4
manure management	1611.4	498.5	422.4	486.6	553.5	596.7
agricultural soils	1407.8	1036.9	1031.8	1393.4	1425.6	1494.4

Table 4-30: Share of direct GHG emissions from agriculture sector, by source categories, under the scenarios considered, %

	1990	2010	2015	2020	2025	2030
BAU						
Total CH_4 emissions, including:	**100**	**100**	**100**	**100**	**100**	**100**
enteric fermentation	82	90	90	87	87	86
manure management	18	10	10	13	13	14
Total N_2O emissions, including:	**100**	**100**	**100**	**100**	**100**	**100**
manure management	44	29	25	25	26	27
agricultural soils	56	71	75	75	74	73
Total direct GHG emissions, including:	**100**	**100**	**100**	**100**	**100**	**100**
enteric fermentation	42	32	31	30	29	28
manure management	31	22	20	20	22	23
agricultural soils	27	46	49	50	49	49
WM						
Total CH_4 emissions, including:	**100**	**100**	**100**	**100**	**100**	**100**
enteric fermentation	82	90	90	87	87	86
manure management	18	10	10	13	13	14
Total N_2O emissions, including:	**100**	**100**	**100**	**100**	**100**	**100**
manure management	44	29	25	23	25	26
agricultural soils	56	71	75	77	75	74
Total direct GHG emissions, including:	**100**	**100**	**100**	**100**	**100**	**100**
enteric fermentation	42	32	31	29	28	27
manure management	31	22	20	20	21	22
agricultural soils	27	46	49	51	51	51

	1990	2010	2015	2020	2025	2030
WAM						
Total CH_4 emissions, including:	**100**	**100**	**100**	**100**	**100**	**100**
enteric fermentation	82	90	90	87	87	87
manure management	18	10	10	13	13	13
Total N_2O emissions, including:	**100**	**100**	**100**	**100**	**100**	**100**
manure management	44	29	25	22	24	24
agricultural soils	56	71	75	78	76	76
Total direct GHG emissions, including:	**100**	**100**	**100**	**100**	**100**	**100**
enteric fermentation	42	32	31	27	27	26
manure management	31	22	20	19	20	21
agricultural soils	27	46	49	54	53	53

Table 4-31: Aggregated direct GHG emissions by sources from agriculture sector under the scenarios considered for 1990-2030, kt CO_2 equivalent

Emission sources	1990	2010	2015	2020	2025	2030
BAU						
3A. Enteric fermentation	2190.7	712.6	654.6	743.3	768.2	792.8
3B. Manure management	1611.4	498.5	422.4	513.2	575.8	641.7
3D. Agricultural soils	1407.8	1036.9	1031.8	1238.0	1291.2	1379.0
3H. Urea application	0.6	1.7	5.8	5.8	5.8	5.8
3. Agriculture	**5210.6**	**2249.7**	**2114.7**	**2500.3**	**2641.0**	**2819.3**
WM						
3A. Enteric fermentation	2190.7	712.6	654.6	724.7	745.9	764.3
3B. Manure management	1611.4	498.5	422.4	498.1	560.3	628.9
3D. Agricultural soils	1407.8	1036.9	1031.8	1317.7	1361.5	1436.1
3H. Urea application	0.6	1.7	5.8	5.8	5.8	5.8
3. Agriculture	**5210.6**	**2249.7**	**2114.7**	**2546.4**	**2673.5**	**2835.1**
WAM						
3A. Enteric fermentation	2190.7	712.6	654.6	713.2	727.3	744.4
3B. Manure management	1611.4	498.5	422.4	486.6	553.5	596.7
3D. Agricultural soils	1407.8	1036.9	1031.8	1393.4	1425.6	1494.4
3H. Urea application	0.6	1.7	5.8	5.8	5.8	5.8
3. Agriculture	**5210.6**	**2249.7**	**2114.7**	**2599.0**	**2712.2**	**2841.4**

As seen from Table 4-31, the plant growing and animal husbandry sectors almost equally share the amount of GHG emissions from the whole agricultural sector: by 2030 the amount of emissions from the animal husbandry sector is expected to be 1434.5 kt CO_2 equivalent (51%) under the BAU, in the plant growing sector it is expected to be 1379 kt CO_2 equivalent (49%); 49% and respectively 51% under the WM; and 47% and 53% under the WAM. As seen from Figure 4-20, the amount of GHG emissions in the agriculture sector during the period until 2030 differs very little from scenario to scenario, which is explained by the fact that the increasing / decreasing evolution of emissions by sources shows opposite trends in the scenarios. Thus, GHG emissions from emission sources 3A "Enteric fermentation" and 3B "Manure management" decrease under the WM and WAM compared to BAU, while GHG emissions from the emission source 3D "Agricultural soils" grow under the WM and WAM compared to BAU during 2015-2030. The impact of mitigation policies in the agricultural sector is limited by the economic growth rate of the sector, because once the quality of life in the rural sector improves and the sector itself recovers, the amounts of organic fertilizers applied to the soil will inevitably increase, what will have a significant cumulative impact on the trends in N_2O emissions from the source category 3D "Agricultural soils".

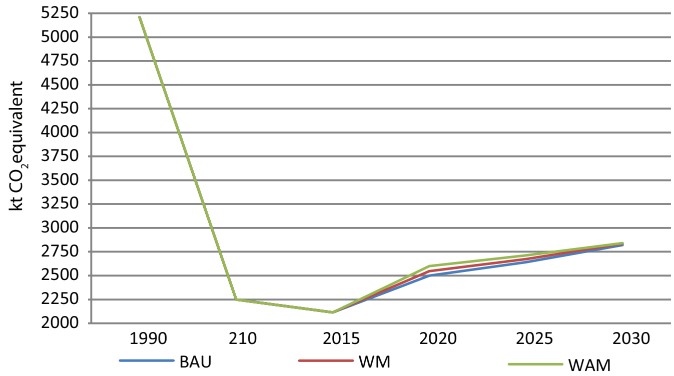


Figure 4-12: Evolution of GHG emissions from the agricultural sector under the scenarios considered.

The increase of GHG emissions after 2015 under all three scenarios is explained by the need to develop the agricultural sector of the RM which was in regression for a long period of time in the past 25 years. In addition to growing emissions in the plant growing sector, emissions will increase in the animal husbandry sector as well, due to the same reason: the need to increase the level of production as a result of higher living standards, which are now at a low level.

By the year 2030 GHG emissions in the agriculture sector under all three scenarios will be about 54% of the same emission levels registered in 1990.

4.3.4. LULUCF Sector

The GHG emissions monitored under the LULUCF sector are the CO_2 emissions. Calculation of GHG emissions/removals has been done in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories and other relevant methodological publications. The main emissions sinks are forest lands, grasslands and lands covered with forest vegetation on croplands, in particular the sub-categories: 4A1 "Forest lands remaining forest lands", 4C2 "Lands converted to grassland" and 4B1 "Croplands remaining croplands". The source categories: 4B2 "Lands converted to croplands, 4E2 "Lands converted to settlement lands" and 4F2 "Land converted to other land" are a constant source of CO_2 emissions as a result of the deeply negative balance resulting from the conversion of land with different vegetation categories, as well as substantial reduction (38.6%) of areas with perennial plantations. It is possible to reduce CO_2 emissions from these sources by creating a positive balance of humus in agricultural soils, by fertilizing the soils with organic matter from all possible sources. In the current situation created in Moldovan agriculture, the only real possibility to increase the flow of organic matter in the agricultural soils is to use green fertilizers. Other sources of organic matter (manure, organic residues, etc.), even if it become possible to use it as organic fertilizer, would solve the problem only for 10% of the croplands. The BAU, WM and WAM scenarios presented below include the abovementioned measures aimed at creating a positive balance of humus in the soil, increasingly from the BAU towards WAM scenarios.

A. Mitigation Scenarios

Based on the policies set out above in Chapter 3, three scenarios for the development of the "Land use, land-use change and forestry" category until the year 2030 were developed and considered.

BAU - reflects development policies and strategies of the forest sector approved during the 01.01.2000-01.01.2010.

WM covers the policies and mitigation measures implemented or adopted after 01.01.2010, estimates their impact by year 2030, and was drafted mainly based on the following legal framework:

- Government Decision no. 1470 of 30.12.2016 on approval of the Low Emission Development Strategy of the Republic of Moldova until 2030 and the Action Plan for its implementation;
- Government Decision no. 593 of 01.08.2011 on approval of the National Program on creation of the National Ecological Network. This programme provides for afforestation of protection ones and stripes of rivers and water basins on an area of 30.4 thousand hectares by the end of 2018;
- Government Decision no. 626 of 20.08.2011 on approval of Soil Fertility Conservation and Enhancement Program for 2011-2020. The programme provides for stabilization through afforestation of 50 thousand hectares of land slides, and planting of 20 thousand ha of protection strips;
- Government Decision no. 301 of 24.04.2014 on approval of the Environmental Strategy for 2014-2023 and the Action Plan for its implementation. One of the specific objectives of the Action Plan is extension of woodland areas up to 15% of the territory of the country, of natural areas protected by the State up to 8.1% of its territory and ensuring the efficient and sustainable management of natural eco-systems. In order to achieve this objective it is planned to plant and rehabilitate the riparian protection stripes and water basins on the surface of 30 thousand ha, forests on degraded lands, green spaces on an area of 150 thousand hectares. These activities are planned for the period until 2023.
- Government Decision no. 101 of 10.02.2014 on approval of the National Plan of expanding the areas with forest vegetation in 2014-2018, which provides for the afforestation of degraded lands, of riparian and water basins protection stripes, as well as forest protection-belts of agricultural lands on the area of 13,041 ha.
- Government decision No. 742 of 21.10.2015 on approval of the Action Plan on the implementation of the National Agricultural and Rural Development Strategy for 2014-2020, which among other things provides for "planting of 24.5 thousand hectares of high productivity vine plantations."

It is necessary to note, that according to statistics, during 2007-2016 the numbers of livestock directly dependent on pastures essentially decreased: the number of cattle has reduced by 38%, sheep and goats - by 8%, equines - by 41%.

WAM – is based on policies and mitigation measures planned to be adopted during the period until 2030 and provides for the growth of indicators related to expansion of areas with other types of vegetation, reflected in draft policy documents, projects financed from international sources, etc., as well as increasing the use of green fertilizers in agriculture. The main benchmark for this scenario is the "NAMA on Afforestation of degraded lands, riverside areas and protection belts"[173], which aims to reverse the trend of forest and land degradation, and to increase carbon removal by 261.6 thousand tons of CO_2 annually until 2030 by planting 45 thousand ha of degraded, unproductive land, 15 thousand ha of riparian forest belts, and 1500 ha of forest protection curtains in agricultural systems. In total, afforestation will be implemented on 61.5 thousand hectares of woodland, at an annual afforestation rate of 4,393 ha. In addition, other measures related to Intended National Determined Contribution, and specified in the Low Emissions Development Strategy of the RM until 2030 and the Action Plan for its implementation will be implemented, including in agriculture.

[173] Developed under the UNDP Project „Low Emissions Capacity Building Program in the Republic of Moldova", 2014-2016.

B. Projections of Economic Indicators

Activity data regarding the evolution of the areas covered with vegetation (Table 4-32 and 4-33) have been generated on the basis of strategies described in the three scenarios mentioned above, and the general trends at global and national levels for the need to improve the qualitative and quantitative indicators for forests and other forest vegetation.

Table 4-32: Evolution of economic indicators for the LULUCF sector in 2005-2030, ha

Indicators	2010	2015	2020	2025	2030
BAU					
Cropland + fallow land	1 846 945	1 863 531	1 863 272	1 862 992	1 862 712
Grassland + pastures	380 918	373 865	369 659	365 104	360 549
Vineyards	149 576	136 170	136 166	136 161	136 156
Orchards	149 210	152 730	152 582	152 422	152 262
Forest vegetation	52 028	51 154	51 154	51 154	51 154
Forest area at the end of the year	410 630	413 482	416 214	419 174	422 133
Areas successfully afforested in the current year	436	617	1 000	1 000	1 000
Buildings, streets, courtyards, markets, roads	233 643	236 483	230 851	229 314	227 778
Swamps	19 394	19 183	17 532	16 590	15 648
Waters	80 246	77 481	77 481	77 481	77 481
Other lands	61 600	59 931	68 715	73 234	77 753
WM					
Cropland + fallow land	1 846 945	1 863 531	1 842 396	1 808 896	1 775 396
Grassland + pastures	380 918	373 865	354 081	323 562	293 044
Vineyards	149 576	136 170	136 151	136 120	136 089
Orchards	149 210	152 730	152 037	150 968	149 898
Forest vegetation	52 028	51 154	59 154	69 154	79 154
Forest area at the end of the year	410 630	413 482	426 336	446 165	465 993
Areas successfully afforested in the current year	436	617	6 700	6 700	6 700
Buildings, streets, courtyards, markets, roads	233 643	236 483	230 851	229 314	227 778
Swamps	19 394	19 183	17 532	16 590	15 648
Waters	80 246	77 481	77 481	77 481	77 481
Other lands	61 600	59 931	81 908	119 677	157 445
WAM					
Cropland + fallow land	1 846 945	1 863 531	1 861 928	1 859 408	1 856 888
Grassland + pastures	380 918	373 865	347 795	306 800	265 805
Vineyards	149 576	136 170	140 142	145 097	150 052
Orchards	149 210	152 730	154 314	155 374	156 434
Forest vegetation	52 028	51 154	55 554	61 054	66 554
Forest area at the end of the year	410 630	413 482	430 420	457 056	483 691
Areas successfully afforested in the current year	436	617	9 000	9 000	9 000
Buildings, streets, courtyards, markets, roads	233 643	236 483	230 851	229 314	227 778
Swamps	19 394	19 183	17 532	16 590	15 648
Waters	80 246	77 481	77 481	77 481	77 481
Other lands	61 600	59 931	59 609	67 452	75 295

Table 4-33: Evolution of growth of wood harvested during authorized and illegal logging detected during 2005-2030

Indicators	2010	2015	2020	2025	2030
BAU					
Total amount of current stands, thousand m^3	1205.4	1117.9	991.1	1013.0	1026.0
Total amount of harvested wood, thousand m^3	470.5	635.3	635.3	635.3	635.3
WM					
Total amount of current stands, thousand m^3	1205.4	1117.9	966.7	947.8	920.1
Total amount of harvested wood, thousand m^3	470.5	635.3	435.0	426.5	414.0
WAM					
Total amount of current stands, thousand m^3	1205.4	1117.9	956.9	921.6	877.5
Total amount of harvested wood, thousand m^3	470.5	635.3	526.3	506.9	482.6

C. Assessment of Mitigation Potential

Assessment of GHG emissions / removals for the sector has been done in accordance with 2006 IPCC Guidelines for National Greenhouse Gas Inventories and other relevant methodological publications, as well as the results of the calculations related to evolution of economic indicators for this sector during 2010-2030 under the three scenarios. As the main mode of presentation of information and calculations, the Land Use Matrix for the period 1970-2015 was used.

The biggest share of gas in the LULUCF sector belong to CO_2 emissions / removals, while other type of gases, CH_4 and N_2O, contribute with a relatively small value to the total amount, representing for 2015, according to the national inventory, approx. 2%, referred to the absolute emissions / removals (59.2 kt CO_2 versus – 2,845.4 kt CO_2 equivalent total) of this sector. For this reason, the detailed examination of the latter gases will not be carried out further. At the same time, their values at those recorded in 2015 are taken into account in the calculation of emissions / removals for all the years of analysis, 1990 - 2030.

Table 4-34 presents the calculations of GHG emissions / removals from the CO_2 emissions sources / sinks in the LULUCF sector, while Figure 4-13 shows the evolution of total GHG emissions / removals in this sector.

According to the data in the Table 4-34, the most significant contribution to the total value of CO_2 emissions / removals belongs to the categories 4A "Forest land" and 4B "Croplands", under all scenarios considered. While for 2020-2030 under the WM and WAM scenarios removals are growing in the category 4A "Forest Land", the category 4B "Cropland" shows the increase in CO_2 emissions, which is caused, on the one hand, by the decrease of the croplands areas, and on the other hand by the too slow CO_2 emissions reduction, a consequence of a catastrophic decrease of organic matter flow in croplands. So, a sharp decrease in soil carbon returned in soil on the account of manure resulted into a shift from a positive soil carbon balance, of plus 0.56 t/ha in 1990, to a deeply negative of minus 0.60 t/ha in 2010. During the 2000-2010 the soil carbon balance in croplands became negative – having decreased on average by 0.50 t/ha/year. As a result, the GHG emissions from category 4B increased from about 1,747.3 kt CO_2 in 1990 to about 1,937.2 kt CO_2 in 2015. Consequently, all scenarios feature a substantial decrease in CO_2 removals in the Republic of Moldova. Compared to 1990, in 2030, the amount of sequestrated CO_2 accounts for only 0.4% under the BAU, 8.3% under WM, and 7% under the WAM scenario.

Table 4-34: CO_2 emissions/removals from LULUCF sector in considered scenarios in the RM during 1990-2030, kt CO_2 equivalent

	1990	2010	2015	2020	2025	2030
BAU						
4. LULUCF	-5882.4	-3297.4	-2845.4	-689.7	-396.1	34.3
4A. Forestry land	-2543.7	-2489.6	-2026.2	-1733.3	-1607.3	-1472.4
4B. Cropland	-578.1	-399.3	-669.9	1029.7	1103.0	1315.7
4C. Grassland	-2850.3	-555.8	-306.2	-131.2	-42.2	25.7
4D. Wetlands	17.4	0.0	0.0	0.0	0.0	0.0
4E. Settlements	84.7	45.6	39.4	8.1	6.9	6.9
4F. Other lands	152.5	131.7	60.8	87.0	93.6	108.5
4G. Harvested Wood Products	-130.1	30.0	56.6	50.0	50.0	50.0
WM						
4. LULUCF	-5882.4	-3297.4	-2845.4	-884.0	-813.1	-426.9
4A. Forestry land	-2543.7	-2489.6	-2026.2	-2118.9	-2172.4	-2223.6
4B. Cropland	-578.1	-399.3	-669.9	992.3	1039.8	1316.6
4C. Grassland	-2850.3	-555.8	-306.2	-3.8	45.1	168.3
4D. Wetlands	17.4	0.0	0.0	-10.3	-10.2	-10.3
4E. Settlements	84.7	45.6	39.4	115.3	148.3	182.5
4F. Other lands	152.5	131.7	60.8	91.3	86.4	89.6
4G. Harvested Wood Products	-130.1	30.0	56.6	50.0	50.0	50.0
WAM						
4. LULUCF	-5882.4	-3297.4	-2845.4	-804.6	-782.2	-350.8
4A. Forestry land	-2543.7	-2489.6	-2026.2	-2000.6	-2138.8	-2276.2
4B. Cropland	-578.1	-399.3	-669.9	948.9	1087.9	1492.3
4C. Grassland	-2850.3	-555.8	-306.2	100.9	133.7	299.9
4D. Wetlands	17.4	0.0	0.0	-13.6	-18.1	-22.6
4E. Settlements	84.7	45.6	39.4	73.6	87.0	101.6
4F. Other lands	152.5	131.7	60.8	36.3	16.2	4.3
4G. Harvested Wood Products	-130.1	30.0	56.6	50.0	50.0	50.0

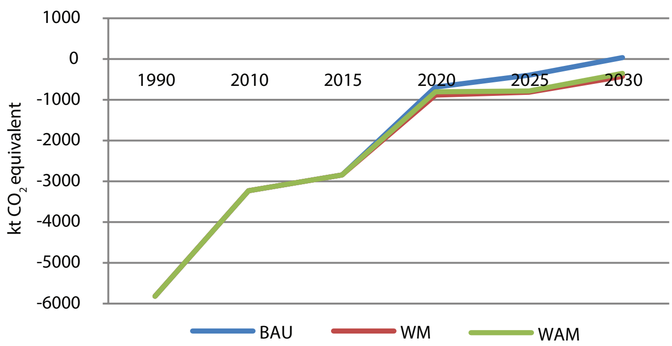


Figure 4-13: CO_2 net emissions / removals for the LULUCF sector under the scenarios considered for 1990-2030.

4.3.5. Waste Sector

Direct GHG emissions (CH_4 and N_2O) from solid waste management activities, including industrial waste (5A "Solid waste disposal", 5C "Incineration and open burning of waste") and from waste water treatment (5D "Waste water treatment and discharge") are monitored in the waste sector. GHG emissions projections were carried out on the basis of methodological approaches set forth in 2006 IPCC Guidelines.

A. Mitigation Scenarios

Based on macroeconomic indicators of the Republic of Moldova three scenarios for the waste sector medium and long-term development were drafted and considered.

BAU - is an option implying insignificant of solid waste generation growth rate in urban areas by about 1% annually during 2016-2020, due to the extension of waste collection systems in rural areas. From 2020 to 2025 it shows a modest increase of 0.5%, while in 2026-2030, the total amount of waste generation will be decreasing by 1% annually, based on demographic trends. Regarding industrial waste, projections show modest annual 1% growth in 2016-2020 and 0.5% in 2020-2030. Emissions from waste disposal by open burning were calculated under assumption that circa 20 % of urban population and about 40 % of rural population which do not have waste treatment systems, generate waste produced by open burning in the 2016-2020 and further, in 2021-2030 the share of the urban population decreases from 20 to 10%, and rural population from 40 to 20%. It should be also mentioned that open burning of medical waste in health care facilities occurs widely until now. In the absence of coercion leverages it is expected that open burning of medical waste will further continue, although a number of operators have been authorized to manage medical waste. Due to this development a modest decrease of burnt amounts by 2% per year can be assumed during 2016-2025, and 5% during 2026-2030. The share of population having centralized sewerage will grow slowly - 2% by the year 2030. The number of population in this period will be decreasing, and protein consumption will be in 2015 - 27.66; in 2020 - 28.67; in 2025 - 28.95 kg/year, without the use of emitted biogas.

WM – provides that solid waste generation rate calculated for the BAU scenario will be influenced by the GHG mitigation measures aimed at promotion and development of recyclable waste recovery systems, including paper, in the urban areas of RM. In Chisinau municipal area this practice is already being implemented. According to statistical data, the amount of waste increases on average by 5% a year, separate collection of waste paper and cardboard accounting for 5% in urban municipalities, and 2% in rural settlements. It should be mentioned that at the stage of feasibility studies for sizing the regional waste management systems, because of lack and uncertainty of data, estimative data was used for estimating municipal waste. For example, these data exceed the statistical value by circa 70% for the waste management area No. 1 (Cahul, Cantemir, Taraclia and partly ATU Gagauzia), which explains the need to include rural localities currently having no sanitation services, in the calculation. Industrial waste disposal, also not included in the statistical reports presented by the sanitation services, thus the estimated difference between data values would be about 25%. Starting from this, while projecting the generation of municipal waste this difference of 25% will be taken into account for the period 2016-2020, on account of the waste collection systems extension in rural areas. Stabilization is expected from 2020 until 2025, while in 2025-2030 total waste generation will decrease by 1% per annum, based on demographic trends. Regarding GHG emissions reduction, it will be determined in the context of NAMA implementation of the NAMA Project Design Document of the "Waste to Energy" Project as a nationally appropriate mitigation action of the Republic of Moldova, which provides for GHG emission reduction contribution of about 3 387 114 t CO_2 equivalent during lifetime and an annual average of about 109 262 t CO_2 equivalent /year in all regional waste deposits. Under this scenario, once regional waste management systems are in place and effective sanitation supervision is promoted in settlements open incineration of waste will gradually decrease. Thus, the share of waste incinerated by open burning will decrease by 2% annually from 20% to 0% in 2025 in urban settlements, and the same approach is proposed to be used for rural settlements, meaning that during 2016-2030 open burning of waste will be reduced by 2% annually, reaching the share of 10% in 2030. Regarding the evolution of the wastewater amount and use of methane emissions, the WM provides for connection to centralized sewerage system of 85% of the urban population and 25% of the rural population by the year 2030[174]. Protein consumption will increase by 2% under the BAU compared to 2015, 3% in 2020 and by 3.5% in 2025, without using the produced biogas.

WAM – corresponds to WM, however, with a much wider extent of implementation based on the Waste Management Strategy, approved by the GD no. 248 of 10.04.2013. With deviation from the Strategy, which provides for construction of a number of a bio-mechanical treatment plants, now at the stage of feasibility studies, construction of one bio-mechanical treatment plant is being considered for Chisinau municipal area only. It should be noted that at the stage the Waste Management Strategy development two options were considered: construction of two bio-mechanical treatment plants and two waste incinerators in Chisinau and Balti. Taking into account the results of the studies on morphological composition of municipal waste in the RM, preference was given to bio-mechanical treatment technology. The impact in the medium-term run (until 2025) of construction of one bio-mechanical treatment plant is reduction of direct GHG emissions from the waste sector by 20%. Similarly, to the WM scenario, open burning of waste will gradually decrease once regional waste management systems become operational, along with the promotion of efficient supervision of sanitation in settlements. Thus, the share of openly burnt waste will decrease by 2% annually, from 20% to 0% in 2025 in urban settlements, and after 2015 in rural settlements open burning of waste will be reduced by 2% annually, reaching the 10% share in 2030. Strict compliance with environmental legislation, together with appropriate financial coverage would allow to stop open burning of medical waste in a shorter time (2016-2025) than provided for under the WM by reducing the annual quantities of burnt staff by 10%, and by 20% during 2026-2030, which would reduce the openly burnt medical waste by 90% by 2030, relative to the year 2015. By the year 2025 the WAM provides for performing sewerage systems in place in Chisinau, Balti, Cahul and Tiraspol, which will ensure reducing the direct GHG emissions from the wastewater to the minimum level. Although previous strategic sectoral programmes provided for sludge treatment systems installed by 2020 at the wastewater treatment plants in 4 cities: Chisinau, Balti, Orhei and Cahul, and Soroca and Ungheni by 2025, the new strategic document does not include actions to reduce GHG emissions originating from waste water management sector. Therefore, it is not possible to achieve GHG emissions reductions. However, the National Program for the Implementation of the Protocol on Water and Health in the Republic of Moldova for the years 2016-2025[175] provides for connecting of 85% of urban population and 25% of rural population to sewerage systems by 2025. Therefore, this scenario assumes connection to the sewage system of 85% of urban population and 25% of rural population, and after 2025, another 10% of the urban population and 15% of the rural population by 2030. This scenario assumes that protein

[174] In the National Programme for the implementation of the Water and Health Protocol in the Republic of Moldova for 2016-2025 these targets are planned to be achieved by 2025

[175] The national programme for the implementation of the Protocol on water and health in the Republic of Moldova for the years 2016-2025. Government decision No. 1063 from 16.09.2016. Official Gazette No. 314 from 20.09.2016.

consumption rates will be similar to the one projected or the WM scenario, increasing relative to the BAU by 2% in 2015, by 3% in 2020 and 3.5% in 2025, without use of released biogas. It should be mentioned that, although measures for the implementation of the EU Urban Waste Water Treatment Directive are being designed, including measures for denitrification, the WAM scenario does not provide for reduction of N_2O emissions because of the insignificant share.

B. Projections of Economic Indicators

Projections of evolution of waste sector specific indicators with direct impact on the GHG emissions under the three scenarios are presented below. Projections regarding the storage of solid waste at managed SWDs (Chisinau), unmanaged SWDs (urban settlements on the right and the left bank of the Dniester river) where sanitation services are available, as well as projections for the industrial waste storage are presented below (Table 4-35), and projections regarding the amount of waste disposed through open burning in Table 4-36.

Table 4-35: Projections regarding the amounts of waste disposed at SWDs in the RM under the BAU scenario in 2015-2030, thousands tons

Indicators	2015	2020	2025	2030
BAU				
MSW	1 270.69	1 336.00	1 369.00	1 302.00
Industrial waste	556.21	584.58	599.34	614.48
Total waste	1 826.90	1 920.09	1 968.58	1 916.61
WM				
MSW	1 270.69	1 621.76	1 834.88	1 744.95
Industrial waste	556.21	709.88	709.88	675.09
Total waste	1 826.90	2 331.64	2 331.64	2 217.37
WAM				
MSW	1 270.69	1 621.76	1 625.49	1 535.56
Industrial waste	556.21	709.88	709.88	675.09
Total waste	1 826.90	2 331.64	2 335.37	2 210.65

Table 4-36: Projections regarding the amount of waste disposed by open burning in the RM in 2015-2030, thousands tons

	2015	2020	2025	2030
Medical waste				
BAU	666.62	602.57	544.68	421.46
WM	666.62	515.82	399.13	235.68
WAM	666.62	393.63	206.61	67.70
Municipal waste				
BAU	49.70	38.58	18.22	17.27
WM	49.70	25.14	10.87	5.15
WAM	49.70	25.14	10.87	5.15

Table 4-37: Projections on total amounts of organic substances contained in industrial and domestic wastewater used for calculating CH_4 emissions from wastewater treatment under scenarios considered for 2015-2030

	2015	2020	2025	2030
BAU, WM, WAM				
TOW dom+ind, t CBO_5	154 276 837	139 849 658	142 859 741	148 501 017

Projections for the total amount of organic substances contained in industrial waste water (TOW_{ind}) and domestic waste water (TOW_{dom}) used for calculating methane emissions from waste water treatment were based on the evolution of population and economic growth (GDP growth), considering the same evolution of TOW for all scenarios of medium- and long-term waste sector development (Table 4-37). Projections regarding the per capita protein consumption used to calculate N_2O emissions from sludge are shown in Table 4-38.

Table 4-38: Projections regarding the per capita protein consumption used to calculate N_2O emissions from domestic wastewater treatment under the scenarios considered for 2015-2030

	2015	2020	2025	2030
	BAU			
Protein, kg/capita/year	26.75	27.77	28.81	29.84
	WM			
Protein, kg/capita/year	26.75	27.56	28.54	29.55
	WAM			
Protein, kg/capita/year	26.75	27.56	28.54	29.55

C. Assessment of Mitigation Potential

Calculation of GHG emissions was done using the standard calculation tool - part of the IPCC 2006 Guideline on National GHG Emissions Inventory, using the results of the calculation of the evolution of some sector-specific indicators over the period 2005-2030 in the analyzed scenarios. The Ranking Methodologies 1 and 3, respectively default emission coefficients, were taken from the 2006 IPCC Guideline on National GHG Emissions Inventory. National emission-specific emission factors have also been used.

Below are the calculations results for the direct GHG emissions from the sources of emissions within the sector (Tables 4-39 and 4-40). As seen from Table 4-35, the main source of GHG emissions in the waste sector during 2015-2030 are 5A "Solid waste disposal", with 70-72% of the total sector, depending on the scenario, followed by 5D "Waste water treatment and discharge", with 20-28% calculated for the same scenarios and conditions.

Table 4-39: Direct GHG emissions from the waste sector in the RM under the scenarios considered for 2015-2030, kt CO_2 equivalent

Emission source	Gas	Scenarios	2015	2020	2025	2030
5A. Solid waste disposal	CH_4	BAU	1087.2	1163.5	1289.5	1342.7
		WM	1087.2	1224.0	1001.5	1090.1
		WAM	1087.2	1223.9	993.2	1050.4
5C. Incineration and open burning of waste	CH_4	BAU	8.3	311.6	150.1	141.2
		WM	8.3	204.5	90.5	43.4
		WAM	8.3	203.1	88.3	41.5
	CO_2	BAU	16.1	6.4	3.1	2.9.
		WM	16.1	4.2	1.8	0.9
		WAM	16.1	4.2	1.8	0.9
	N_2O	BAU	2.3	2.4	2.1	1.7.
		WM	2.3	2.0	1.6	0.9
		WAM	2.3	1.6	0.8	0.3
	Total	BAU	26.7	320.4	155.3	145.7
		WM	26.7	210.7	93.9	45.2
		WAM	26.7	208.8	90.9	42.6
5D. Wastewater treatment and disposal	CH4	BAU	354.2	332.3	343.2	361.6
		WM	354.2	321.8	320.8	326.6
		WAM	354.2	315.4	310.3	309.9
	N2O	BAU	70.7	57.2	56.3	55.2
		WM	70.7	56.8	55.7	54.7
		WAM	70.7	56.8	55.7	54.7
	Total	BAU	424.8	389.5	399.5	416.8
		WM	424.8	378.6	376.6	381.3
		WAM	424.8	372.2	366.0	364.6
Total		**BAU**	**1538.7**	**1873.5**	**1844.3**	**1905.3**
		WM	**1538.7**	**1813.2**	**1471.9**	**1516.5**
		WAM	**1538.7**	**1804.9**	**1450.0**	**1457.6**

Table 4-40: Share of GHG emissions by emission sources related to total GHG emissions from the waste sector, %

Emission source	Gases emitted	Scenarios	2015	2020	2025	2030
5A. Solid waste disposal	CH_4	BAU	70.7	62.1	69.9	70.5
		WM	70.7	67.5	68.0	71.9
		WAM	70.7	67.8	68.5	72.1
5C. Incineration and open burning of waste	CH_4	BAU	0.5	16.6	8.1	7.4
		WM	0.5	11.3	6.1	2.9
		WAM	0.5	11.3	6.1	2.8
	CO_2	BAU	1.0	0.3	0.2	0.2
		WM	1.0	0.2	0.1	0.1
		WAM	1.0	0.2	0.1	0.1
	N_2O	BAU	0.1	0.1	0.1	0.1
		WM	0.1	0.1	0.1	0.1
		WAM	0.1	0.1	0.1	0.0
	Total	BAU	1.7	17.1	8.4	7.6
		WM	1.7	11.6.	6.4	3.0
		WAM	1.7	11.6.	6.3	2.9.
5D. Wastewater treatment and disposal	CH_4	BAU	23.0	17.7	18.6	19.0
		WM	23.0	17.7	21.8	21.5
		WAM	23.0	17.5	21.4	21.3
	N_2O	BAU	4.6	3.1	3.1	2.9
		WM	4.6	3.1	3.8	3.6
		WAM	4.6	3.1	3.8	3.8
	Total	BAU	27.6	20.8	21.7	21.9
		WM	27.6	20.9	25.6	25.1
		WAM	27.6	20.6	25.2	25.0

Figure 4-14 shows the evolution of direct GHG emissions from the waste sector of the RM in 1990-2030.

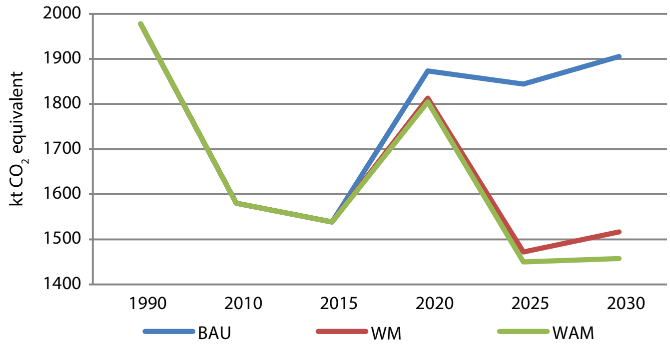


Figure 4-14: Evolution of direct GHG emissions in the waste sector for the scenarios examined for the period 1990-2030.

Before 2015 all scenarios show a decrease in GHG emissions, with subsequent increase by 2020, then, until 2025 a new, more pronounced decrease is seen under the WM and WAM scenarios. Starting with 2025 a slight increase in emissions for all scenarios considered is observed. By the year 2030 the level of direct GHG emissions under the BAU will exceed by 20.6% the emissions levels recorded in 2010, while under the WM and WAM the emissions will decrease respectively by 4.1% and 7.8%. Compared to 1990, the decrease of emissions under the last two scenarios is even more pronounced - 23.3% under the WM and 26.3% under the WAM. The BAU scenario also shows a decrease of GHG emissions in 2030, of 3.7% compared to 1990.

4.4. Medium-Term Projections of Aggregate National Direct GHG Emissions

Tables 4-41 and 4-42 show the results of aggregated national and sector direct GHG emissions projections under the scenarios considered (BAU, WM and WAM) for 1990-2030.

Table 4-41: Aggregated projections for sector and national direct GHG emissions in the RM under the scenarios considered for the period up to 2030, kt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
Energy	34 631	11 885	6 788	8 682	9 829	9 505	8 834	10 447	12 497
Industrial processes and product use	1 581	454	319	599	604	795	1 150	1 447	1 834
Agriculture	5 211	3 591	2.500	2 577	2.250	2115	2500	2641	2819
LULUCF	-5 820	-6 482	-6 057	-4 764	-3 232	-2845	-690	-396	34
Waste	1 978	1 720	1 601	1 557	1 580	1539	1873	1844	1905
Total (with LULUCF)	37 580	11 167	5 151	8 650	11 031	11 108	13 668	15 983	19 089
Total (without LULUCF)	43 400	17 649	11 208	13 414	14 263	13 953	14 358	16 379	19 055
WM									
Energy	34 631	11 885	6 788	8 682	9 829	9 505	8 227	9 640	10 701
Industrial processes and product use	1 581	454	319	599	604	795	1038	1239	1461
Agriculture	5 211	3 591	2.500	2 577	2.250	2115	2546	2674	2835
LULUCF	-5 820	-6 482	-6 057	-4 764	-3 232	-2845	-884	-813	-427
Waste	1 978	1 720	1 601	1 557	1 580	1539	1813	1472	1516
Total (with LULUCF)	37 580	11 167	5 151	8.650	11 031	11 108	12 741	14 212	16 086
Total (without LULUCF)	43 400	17 649	11 208	13 414	14 263	13 953	13 625	15 025	16 512
WAM									
Energy	34 631	11 885	6 788	8 682	9 829	9 505	6 955	7 865	8 502
Industrial processes and product use	1 581	454	319	599	604	795	971	1121	1285
Agriculture	5 211	3 591	2.500	2 577	2.250	2115	2599	2712	2841
LULUCF	-5 820	-6 482	-6 057	-4 764	-3 232	-2845	-805	-782	-351
Waste	1 978	1 720	1 601	1 557	1 580	1539	1805	1450	1458
Total (with LULUCF)	37 580	11 167	5 151	8 650	11 031	11 108	11 525	12 365	13 735
Total (without LULUCF)	43 400	17 649	11 208	13 414	14 263	13 953	12 329	13 148	14 086

Table 4-42: Contribution of sectors to the structure of the national direct GHG emissions in the RM under the scenarios considered for the period 1990-2030, in %

Years	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
Energy	79.8	67.3	60.6	64.7	68.9	68.1	61.5	63.8	65.6
Industrial processes and product use	3.6	2.6	2.8	4.5	4.2	5.7	8.0	8.8	9.6
Agriculture	12.0	20.3	22.3	19.2	15.8	15.2	17.4	16.1	14.8
LULUCF	-13.40	-36.7	-54.0	-35.5	-22.7	-20.4	-4.8	-2.4	0.2
Waste	4.6	9.7	14.3	11.6	11.1	11.0	13.0	11.3	10.0
Total (with LULUCF)	86.6	63.3	46.0	64.5	77.3	79.6	95.2	97.6	100.2
Total (without LULUCF)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WM									
Energy	79.8	67.3.for	60.6	64.7	68.9	68.1	60.4	64.2	64.8
Industrial processes and product use	3.6	2.6.	2.8.	4.5	4.2	5.7	7.6	8.2	8.8
Agriculture	12.0	20.3.	22.3	19.2	15.8	15.2	18.7	17.8	17.2
LULUCF	-13.40	-36.7	-54.0	-35.5	-22.7	-20.4	-6.5	-5.4	-2.6
Waste	4.6	9.7	14.3	11.6	11.1	11.0	13.3	9.8	9.2
Total (with LULUCF)	86.6	63.3	46.0	64.5	77.3	79.6	93.5	94.6	97.4
Total (without LULUCF)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WAM									
Energy	79.8	67.3	60.6	64.7	68.9	68.1	56.4	59.8	60.4
Industrial processes and product use	3.6	2.6	2.8	4.5	4.2	5.7	7.9	8.5	9.1
Agriculture	12.0	20.3	22.3	19.2	15.8	15.2	21.1	20.6	20.2
LULUCF	-13.40	-36.7	-54.0	-35.5	-22.7	-20.4	-6.5	-5.9	-2.5
Waste	4.6	9.7	14.3	11.6	11.1	11.0	14.6	11.0	10.3
Total (with LULUCF)	86.6	63.3	46.0	64.5	77.3	79.6	93.5	94.1	97.5
Total (without LULUCF)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Compared to 1990, implementation of the planned GHG emissions mitigation measures will allow to reduce total national direct GHG emissions (without LULUCF) by about 62% under the WM and by about 68% under the WAM by the year 2030, respectively, net national direct GHG emissions (with LULUCF), by about 57% under the WM, and by 63% under the WAM (Figure 4-15).

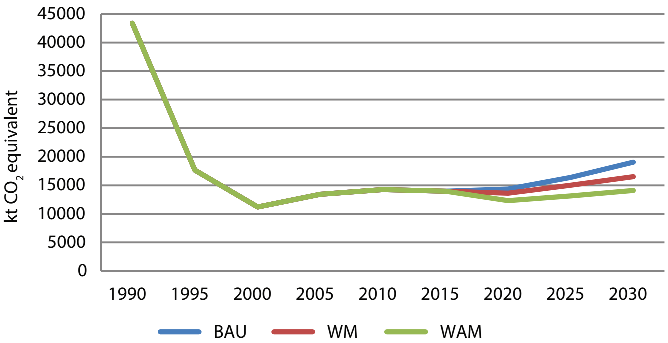


Figure 4-15: Aggregate projections of total direct GHG emissions in the Republic of Moldova (without LULUCF) under the scenarios considered for the period up to 2030.

As seen in Figure 4-16, LULUCF sector significantly influence net GHG emission reductions. The emission reductions mentioned above differ from those stipulated in the unconditional and conditional INDC undertaken by the Republic of Moldova under Paris Agreement (COP 21). According to this document, the RM shall reduce its net GHG emissions unconditionally by 64-67% by the year 2030 compared to 1990, compared to the 57% above, and conditionally by 78%, compared to 63% according to this National Communication. The difference in GHG emissions reductions is caused by a number of factors: as a result of transition , during the development of the Fourth National Communication, to the 2006 IPCC Guidelines calculation methodologies, preferred to those set forth in the Good Practice Guidance (IPCC, 2000) and the Revised 1996 Guidelines (IPCC, 1997), as a result of updating the activity data used, and country specific emission values; smaller population numbers were considered, based on results of the population census of 2014 in the RM; revised GDP evolution until 2030 RM.

Consequently, aiming at complying with international commitments to reduce greenhouse gas emissions, the Republic of Moldova should reconsider its INDC, if such possibilities will arise in the future, or to respectively amend its sustainable development policies, which served as basis for the Fourth National Communication.

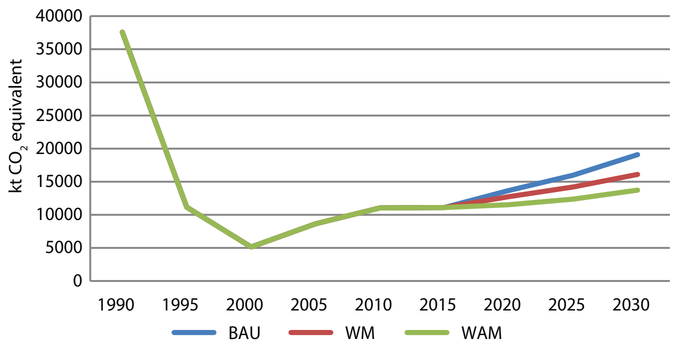


Figure 4-16: Aggregate projections of net direct GHG emissions in the Republic of Moldova (with LULUCF) under the scenarios considered for the period up to 2030.

Implementation of GHG emissions mitigation measures will directly influence re-distribution of shares the various sectors in the structure of national GHG emissions (Table 4-43 and Table 4-44).

Table 4-43: Projections for direct GHG emissions in the Republic of Moldova under the scenarios considered for the period until 2030, kt CO_2 equivalent

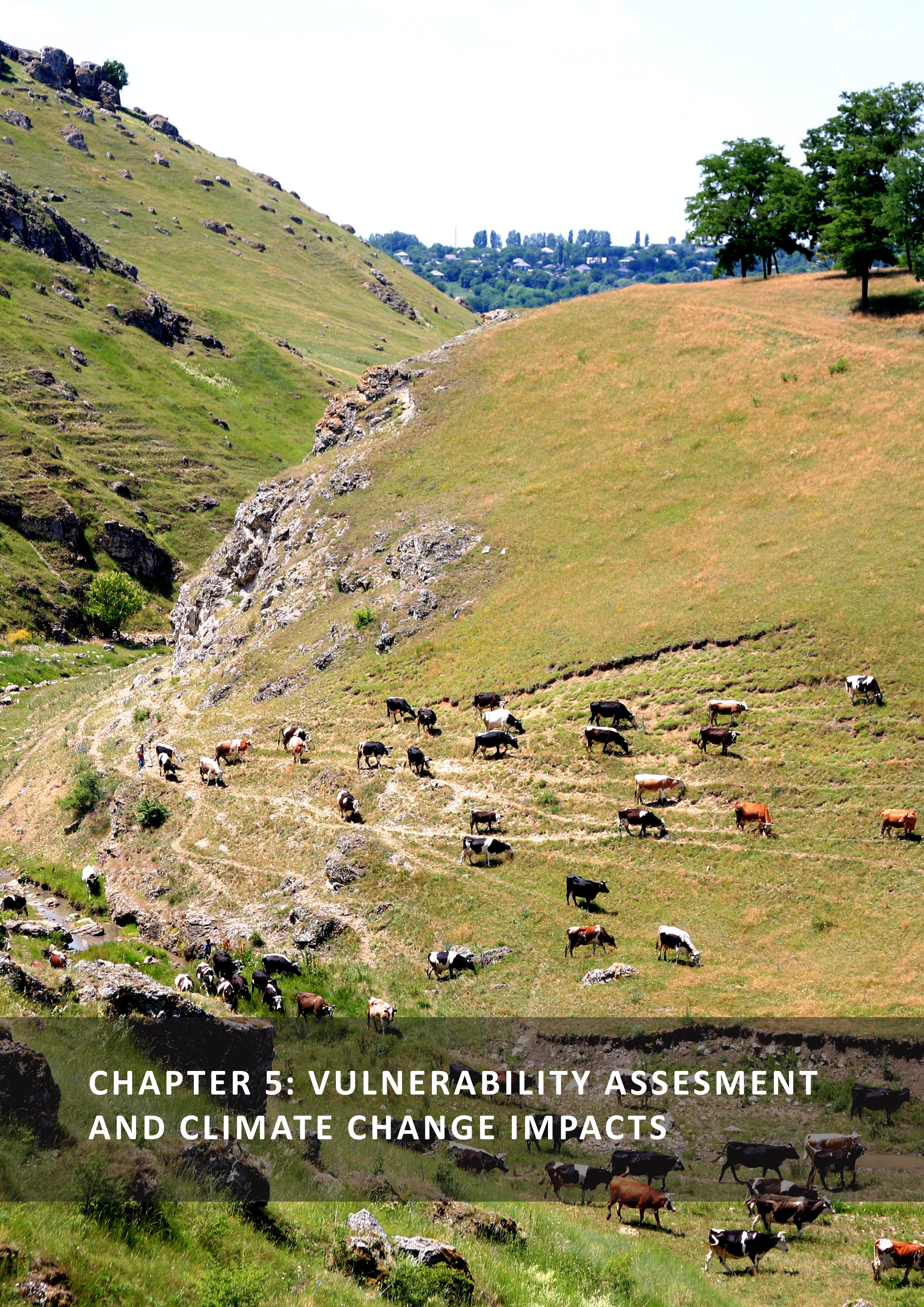
	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
CO_2 emissions	34 895	11 588	6450	8461	9657	9397	9030	10822	13093
CH_4 emissions	5704	4167	3321	3303	2913	2863	3262	3274	3373
N_2O emissions	2801	1889	1426	1684	1579	1573	1812	1924	2074
F-gases emissions	NO	5	10	42	113	179	313	417	573
Total GHG emissions	43 400	17 649	11 208	13 490	14 263	14 013	14 417	16 438	19 114
WM									
CO_2 emissions	34 895	11 588	6450	8461	9657	9397	8333	9841	10998
CH_4 emissions	5704	4167	3321	3303	2913	2863	3180	2872	2946
N_2O emissions	2801	1889	1426	1684	1579	1573	1870	1972	2110
F-gases emissions	NO	5	10	42	113	179	302	399	516
Total GHG emissions	43 400	17 649	11 208	13 490	14 263	14 013	13 684	15 084	16 572
WAM									
CO_2 emissions	34 895	11 588	6450	8461	9657	9397	7033	8009	8714
CH_4 emissions	5704	4167	3321	3303	2913	2863	3150	2816	2848
N_2O emissions	2801	1889	1426	1684	1579	1573	1934	2031	2139
F-gases emissions	NO	5	10	42	113	179	272	351	444
Total GHG emissions	43 400	17 649	11 208	13 490	14 263	14 013	12 389	13 207	14 145

Thus, if in 2010 about 68.9% of national direct GHG emissions were from the energy sector, 15.8% from agriculture sector, 11.1% from the waste sector and the remaining 4.2% - from the IPPU sector, by the year 2030 the share of these sectors in the structure of national direct GHG emission will change, especially under the WM and WAM, featuring a smaller share of the energy sector and an increase of other sectors share: under the WM scenario, the share of sectors in the structure of national direct GHG emissions will look as follows: energy sector - 63.8%, IPPU sector - 8.8%, agriculture sector – 17.2% and waste sector – 9.2%; under the WAM scenario: energy sector -60.4%, IPPU sector - 9.1%, agriculture sector – 20.2% and waste sector – 10.3%.

During 2010-2030 CO_2 total emissions (without LULUCF) will increase by about 35.6% under the BAU, by 13.9% under the WM and will decrease by 9.8% under the WAM; CH_4 emissions will increase by about 15.8% under the BAU, by 1.1% under the WM, and will decrease by 2.2% under the WAM; N_2O emissions will increase by about 31.4% under the BAU, by 33.7% under the WM and by 35.5% under the WAM; respectively; F-gas emissions will increase by 405.6% under the BAU, by 355.3% under the WM and by 291.7% under the WAM.

Table 4-44: Projections for direct GHG emissions in the RM under the scenarios considered for the period until 2030, %

	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU									
CO_2 emissions	80.4	65.7	57.6	62.7	67.7	67.1	62.6	65.8	68.5
CH_4 emissions	13.1	23.6	29.6	24.5	20.4	20.4	22.6	19.9	17.6
N_2O emissions	6.5	10.7	12.7	12.5	11.1	11.2	12.6	11.7	10.9
F-gases emissions	0.0	0.0	0.1	0.3	0.8	1.3	2.2	2.5	3.0
Total GHG emissions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WM									
CO_2 emissions	80.4	65.7	57.6	62.7	67.7	67.1	60.9	65.2	66.4
CH_4 emissions	13.1	23.6	29.6	24.5	20.4	20.4	23.2	19.0	17.8
N_2O emissions	6.5	10.7	12.7	12.5	11.1	11.2	13.7	13.1	12.7
F-gases emissions	0.0	0.0	0.1	0.3	0.8	1.3	2.2	2.6	3.1
Total GHG emissions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
WAM									
CO_2 emissions	80.4	65.7	57.6	62.7	67.7	67.1	56.8	60.6	61.6
CH_4 emissions	13.1	23.6	29.6	24.5	20.4	20.4	25.4	21.3	20.1
N_2O emissions	6.5	10.7	12.7	12.5	11.1	11.2	15.6	15.4	15.1
F-gases emissions	0.0	0.0	0.1	0.3	0.8	1.3	2.2	2.7	3.1
Total GHG emissions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0



CHAPTER 5: VULNERABILITY ASSESMENT AND CLIMATE CHANGE IMPACTS

CHAPTER 5: VULNERABILITY ASSESSMENT AND CLIMATE CHANGE IMPACTS

5.1. Current Climate of the Republic of Moldova

5.1.1. Summary of Observed Trends in Temperature and Precipitation

Over the last 127 years (1887-2014), the RM has experienced changes in temperature and mean precipitation. The country has become warmer, with the average temperature increase greater than 1.0°C (**Figure 5-1**), while the increase in precipitations constituted only around 54.7 mm (**Figure 5-2**).

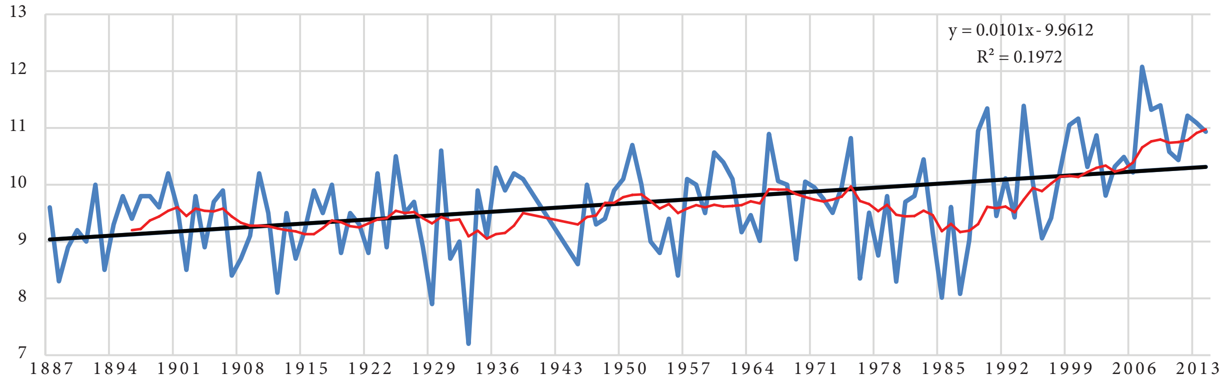


Figure 5-1: Trends of annual average air temperature change (°C) for 1887-2014: blue (actual course trend), black solid line (linear trend secular course) and red line (10-year moving average trend) at the meteorological station Chisinau, central part of the country.

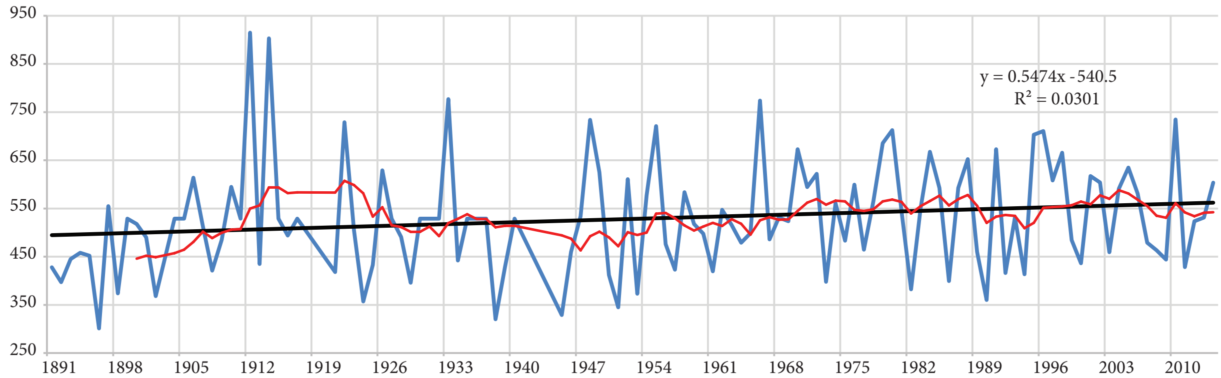


Figure 5-2: Trends of annual average precipitation (mm) for 1891-2014: blue (actual course trend), black solid line (linear trend secular course) and red line (10-year moving average trend) at the meteorological station Chisinau, central part of the country.

The early 1980s are generally regarded as a kind of „breaking point" in the long-term air temperature curve, from which the human influence on the atmosphere is expressed most distinctly (IPCC, 2007); this fact was confirmed statistically both by foreign (Gil-Alana, 2008) and national studies (Corobov et al, 2013; Taranu, 2014). The annual course of mean air temperature in the RM, with a maximum in July-August and a minimum in January, and total precipitation, maximum in July and minimum in March, is shown in **Figure 5-3**.

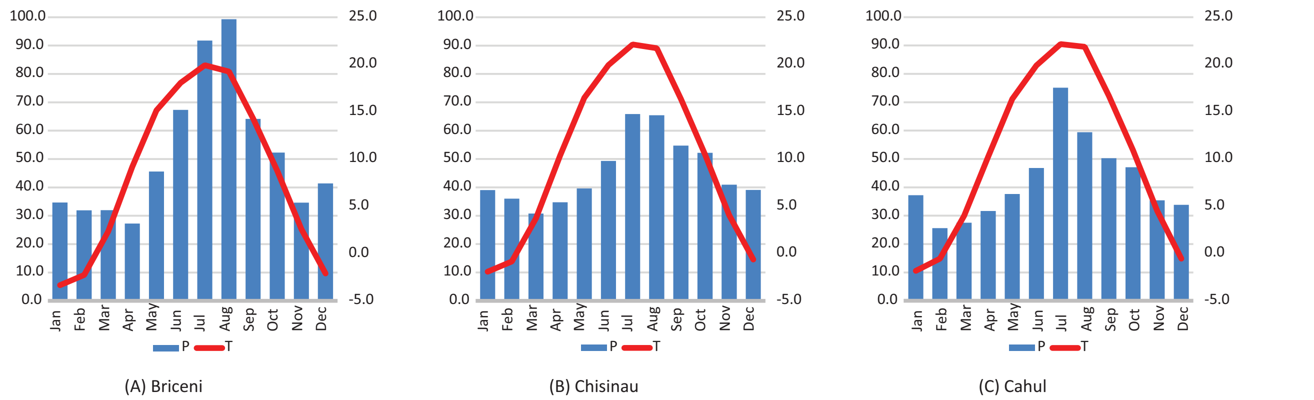


Figure 5-3: Diagrams of total monthly precipitation (columns) with superimposed curves of mean monthly temperatures in different areas.

Their average numerical values in the seasonal aspect are listed in Table 5-1. The temperature rise in a southern direction is clearly seen (from an average annual value of 8.5°C in the North to 10.3°C in the South, followed by a decrease in the amount of annual precipitation, respectively, from 622 mm to 508 mm. However, as it follows from the above definition of climate, it is described not only by the mean values, but also by their variability, which is usually characterized by standard deviations (σ) from the medium. The ratio of σ to the mean value (x), expressed as a percentage, or the so-called coefficient of variation (CV) provides an easily interpretable magnitude of the climate variability variable.

$$CV=\sigma/x \times 100\% \quad (1.1)$$

The temperature is the most variable in the winter, reaching 50% or more for the mean, maximum and minimum temperatures. The least variable are the mean, maximum and minimum summer temperatures, when the CV ranges from 4.7 to 7.4%. With regard to annual temperatures, they range from 7.9 (Briceni) - 8.2% (Cahul) for maximum temperatures to up to 13.1 (Cahul) - 20% (Briceni) for minimum temperatures. Variability of precipitation is considerably higher and it is > 30% for all seasons, with the exception of the annual precipitation (Table 5-1).

Trends in air temperature and precipitation calculated by linear regression analysis are shown in **Figures 5-4** and **5-5**, and more details are provided in **Table 5-2**.

Table 5-1: Mean air temperatures and total precipitation over the period 1981-2010 and their inter-annual variability

Season	Observations at the meteorological stations					
	Briceni		Chisinau		Cahul	
	X	CV,%	X	CV,%	X	CV,%
Maximal air temperature, °C						
Winter	0.4	>50	1.9	>50	2.3	>50
Spring	14.2	11.6	15.2	11.4	15.6	12.1
Summer	24.8	4.7	26.7	5.4	27.0	5.5
Autumn	13.2	9.4	14.7	8.0	15.4	8.5
Annual	13.1	7.9	14.6	7.9	15.1	8.2
Mean air temperature, °C						
Winter	-2.6	>50	-1.1	>50	-1.0	>50
Spring	8.9	14.7	10.2	13.1	10.2	13.7
Summer	19.1	5.7	21.3	5.5	21.3	5.6
Autumn	8.5	11.0	10.3	10.4	10.7	10.6
Annual	8.5	12.4	10.2	9.6	10.3	9.8
Minimal air temperature, °C						
Winter	-5.3	39.0	-3.7	48.4	-3.6	44.3
Spring	4.3	23.6	5.9	17.1	5.8	17.5
Summer	14.0	7.4	16.5	6.0	16.3	5.6
Autumn	4.8	23.8	6.7	16.2	6.9	15.4
Annual	4.5	20.0	6.4	13.6	6.3	13.1
Precipitation, mm						
Winter	99.6	42.0	105.8	48.4	90.4	40.8
Spring	140.2	35.5	123.7	43.8	116.1	49.8
Summer	255.3	30.8	186.1	41.0	184.8	51.9
Autumn	128.3	48.7	132.2	55.3	116.3	44.2
Annual	622.4	23.0	547.7	19.8	507.6	23.4

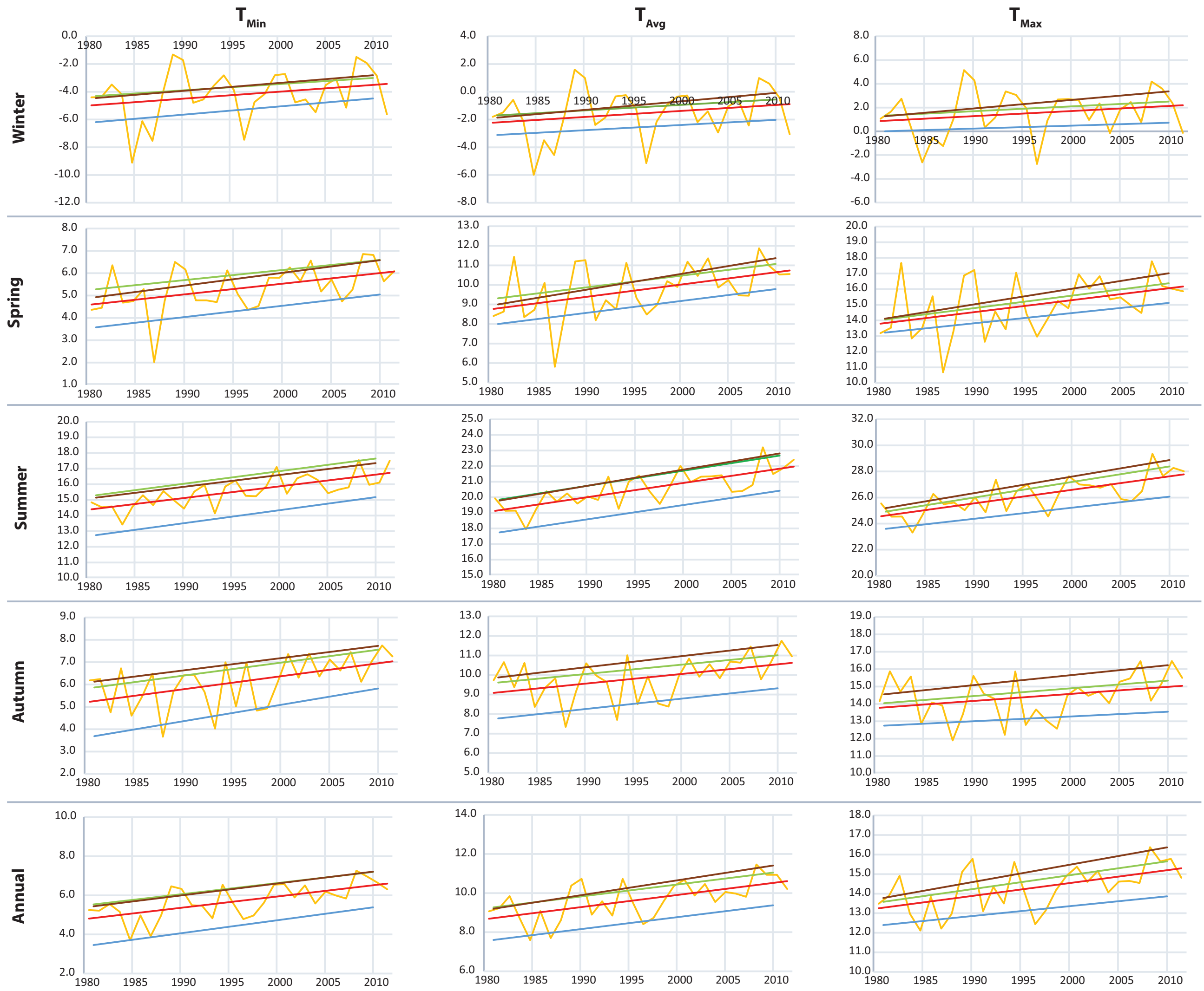


Figure 5-4: Trends in air temperature for 1981-2010: Briceni - blue, Chisinau - green, Cahul - brown, the red linear trend - the average for the RM; the yellow curve shows the inter-annual temperature variability for the Republic of Moldova.

The positive trend rate on all graphs shows a temperature rise with different intensity in all seasons and on all territory of the RM. The statistical significance of the trend is shown by their *p*-values. Trends, where $p<0.10$, underlined in the table by shading should be considered as valid with 90% confidence level. In many cases, the statistical significance is significantly higher ($p<0.05$, and even <0.001).

The air temperature rises on the territory of the RM over the years 1981-2010 bears no doubt and it is most clearly seen during the warm season, especially in summer, when the mean temperature rises by 0.9-1.0°C, and T_{max} - by 0.9-1.3°C per decade with a very high degree of certainty. Climate is getting warmer to a lesser degree during the winter months, by 0.4-0.6°C per decade and this growth is statistically significant ($p\geq0.10$) only for Cahul.

For the southern regions, the greatest temperature rise is registered due to T_{max}, while for the northern and central regions - due to T_{min}. In the transitional seasons, the greatest statistically significant increase in temperature is observed for T_{max} in the spring of 0.7°C (Briceni) to 1.0°C (Cahul) over the decade, and the lowest over autumn of 0.3°C (Briceni) to 0.6°C (Cahul) per decade. However, T_{min} shows a reverse pattern with autumn growth of 0.6°C (Cahul) to 0.7°C (Briceni) as compared to 0.5°C (Briceni) and 0.6°C (Cahul) per decade in spring.

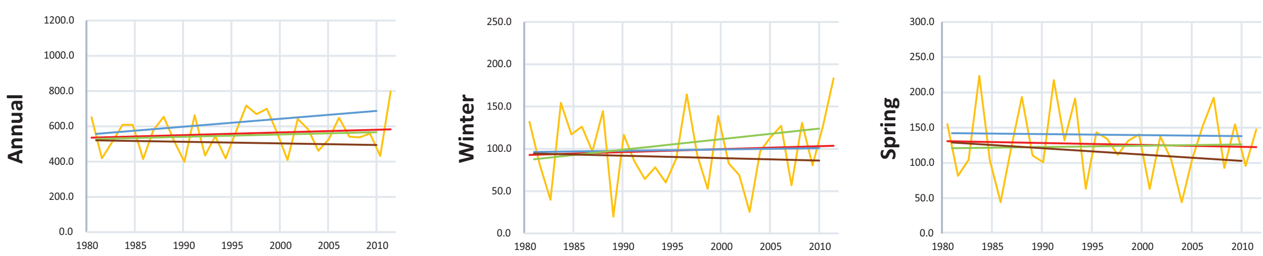
In annual terms, also the largest increase T_{max} 0.9°C per decade is observed in Cahul against 0.5°C in Briceni, while the largest increase in T_{min} is observed, on the contrary, in Briceni 0.7°C per decade as opposed to 0.6°C in Cahul (**Table 5-2, Figure 5-5**).

Table 5-2: Indicators of linear trends of temperature and precipitation

Season	Observation site								
	Briceni			Chisinau			Cahul		
	r_0	r_1	p	r_0	r_1	p	r_0	r_1	p
Maximal air temperature, °C									
Winter	-0.02	0.025	0.5652	+1.28	0.041	0.3235	+1.20	0.072	0.0641
Spring	+13.15	0.066	0.0569	+13.98	0.080	0.0266	+14.01	0.100	0.0095
Summer	+23.51	0.086	0.0001	+24.80	0.120	0.0000	+25.07	0.127	0.0000
Autumn	+12.72	0.029	0.2982	+13.99	0.045	0.0716	+14.49	0.058	0.0348
Annual	+12.34	0.051	0.0169	+13.51	0.071	0.0020	+13.69	0.089	0.0002
Mean air temperature, °C									
Winter	-3.15	0.038	0.3689	-1.74	0.040	0.3000	-1.92	0.061	0.0725
Spring	+7.94	0.062	0.0223	+9.25	0.060	0.0287	+8.92	0.081	0.0037
Summer	+17.65	0.092	0.0000	+19.76	0.097	0.0000	+19.69	0.104	0.0000
Autumn	+7.73	0.053	0.0149	+7.96	0.042	0.0708	+9.82	0.057	0.0139
Annual	+7.54	0.061	0.0008	+9.21	0.061	0.0014	+9.13	0.076	0.0000
Minimal air temperature, °C									
Winter	-6.25	0.059	0.1854	-4.35	0.045	0.2376	-4.51	0.057	0.0955
Spring	+3.52	0.051	0.0159	+5.24	0.045	0.0328	+4.87	0.057	0.0050
Summer	+12.67	0.084	0.0000	+15.22	0.081	0.0000	+15.07	0.076	0.0000
Autumn	+3.61	0.073	0.0083	+5.81	0.058	0.0083	+6.07	0.055	0.0111
Annual	+3.39	0.067	0.0000	+5.48	0.057	0.0007	+5.38	0.061	0.0000
Precipitation, mm									
Winter	96.215	0.156	0.8621	86.464	1.248	0.2548	94.854	-0.288	0.7181
Spring	142.52	-0.150	0.8890	120.76	0.187	0.8733	130.09	-0.903	0.4693
Summer	208.41	3.022	0.0678	207.85	-1.406	0.3919	194.98	-0.656	0.7519
Autumn	105.96	1.440	0.2813	112.19	1.291	0.4118	101.90	0.930	0.4006
Annual	553.10	4.470	0.1409	527.27	1.321	0.5725	521.83	-0.916	0.7219

Legend: r_0 – free term; r_1 - regression coefficient (trend coefficient); p - statistical significance of the trend

Unlike temperature, statistically significant changes in precipitation are not observed, except for a statistically significant increase in summer precipitation of 30 mm per decade for Briceni. The upward trend in mean annual rainfall is observed in the North (44.7 mm) and the Centre (13.2 mm) per decade, while for the South the trend is towards a reduced growth of autumn precipitation of 9.2 mm per decade. Moreover, a trend towards decrease of precipitation is observed in the South during all seasons, except autumn, while in the centre decrease is seen only in summer.



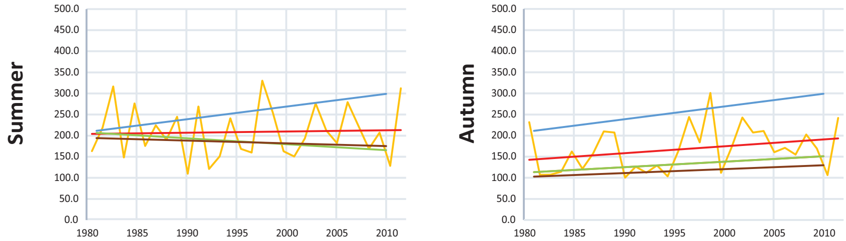


Figure 5-5: Trends in precipitation over period 1981-2010: Briceni - blue, Chisinau - green, Cahul - brown, red linear trend - the average for the RM; the yellow curve shows the inter-annual fluctuations in precipitation for the RM.

5.1.2. Summary of Observed Trends in Extremes Indices

Extreme climate events and their changes are of particular relevance to society and ecosystems due to their potentially severe impacts as emphasized in the Special Report on Extreme Events (SREX) of the Intergovernmental Panel on Climate Change (IPCC, 2012). Correspondingly, the demand for consistent and robust projections of future changes in climate extremes has rapidly increased over the past decade. To facilitate the investigation of observed and projected changes, particularly in temperature and precipitation extremes, the Expert Team on Climate Change Detection and Indices (ETCCDI) defined a set of climate change indices focusing on extreme events. These indices in general describe moderate extreme events with a re-occurrence time of 1 year or less, forming a balance between data availability and robustness of changes (Zhang et al., 2011).

The ETCCDI climate change indices, simply referred to as indices in the following, have been widely used for analysing global changes in extremes in observational records (e.g., Frich et al., 2002; Kiktev et al., 2003; Alexander et al., 2006) as well as in future climate projections (e.g., Tebaldi et al., 2006; Sillmann and Roeckner, 2008; Orlowsky and Seneviratne, 2012). In the guidelines of the World Meteorological Organization (WMO) on the analysis of extremes in a changing climate (Klein Tank et al., 2009), it is further pointed out *"Projected changes in the indices are indicative of future climate change in extremes. By using the same definitions of extremes and analysing the data in a standardized way, it is possible to compare results from different places and to obtain coherent pictures of change around the world".*

5.1.2.1. Climate Extremes Indices Definition

The indices are defined and described in detail in Klein Tank et al. (2009) and Zhang et al. (2011). The indices fall roughly into four categories:

1) absolute indices, which describe, for instance, the hottest or coldest day of a year, or the annual maximum 1 day or 5-day precipitation rates;
2) threshold indices, which count the number of days when a fixed temperature or precipitation threshold is exceeded, for instance, frost days or tropical nights;
3) duration indices, which describe the length of wet and dry spells, or warm and cold spells;
4) percentile-based threshold indices, which describe the exceedance rates above or below a threshold which is defined as the 10th or 90th percentile derived from the 1961–1990 base period. The latter are referred to as percentile indices in the following.

The complete set of 27 indices is summarized in **Table 5-3**.

Table 5-3: Core set of 27 Extreme Indices Recommended by the ETCCDI

Label	Index Name	Index Definition	Units
TN10p	Cold nights	Let TN_{ij} be the daily minimum temperature on day *i* in period *j* and let $TN_{in}10$ be the calendar day 10th percentile centred on a 5-day window. The percentage of days in a year is determined where $TN_{ij} < TN_{in}10$	%
TX10p	Cold days	Let TX_{ij} be the daily maximum temperature on day *i* in period *j* and let $TX_{in}10$ be the calendar day 10th percentile centred on a 5-day window. The percentage of days is determined where $TX_{ij} < TX_{in}10$	%
TN90p	Warm nights	Let TN_{ij} be the daily minimum temperature on day *i* in period *j* and let $TN_{in}90$ be the calendar day 90th percentile centred on a 5-day window. The percentage of days is determined where $TN_{ij} > TN_{in}90$	%
TX90p	Warm days	Let TX_{ij} be the daily maximum temperature on day *i* in period *j* and let $TX_{in}90$ be the calendar day 90th percentile centred on a 5-day window. The percentage of days is determined where $TX_{ij} > TX_{in}90$	%
WSDI	Warm spell duration	Let TX_{ij} be the daily maximum temperature on day *i* in period *j* and let $TX_{in}90$ be the calendar day 90th percentile centred on a 5-day window for the base period 1961–1990. Then the number of days per period is summed where, in intervals of at least 6 consecutive days: $TX_{ij} > TX_{in}90$	Days
CSDI	Cold spell duration	Let TN_{ij} be the daily minimum temperature on day *i* in period *j* and let $TN_{in}10$ be the calendar day 10th percentile centred on a 5-day window for the base period 1961–1990. Then the number of days per period is summed where, in intervals of at least 6 consecutive days: $TN_{ij} < TN_{in}10$	Days
TX_X	Max TX	Let TX_x be the daily maximum temperatures in month *k*, period *j*. The maximum daily maximum temperature each month is then: $TX_{xkj} = max(TX_{xkj})$	C
TX_N	Min TX	Let TX_n be the daily maximum temperature in month *k*, period *j*. The minimum daily maximum temperature each month is then: $TX_{nkj} = min(TX_{nkj})$	C
TN_X	Max TN	Let TN_x be the daily minimum temperatures in month *k*, period *j*. The maximum daily minimum temperature each month is then: $TN_{xkj} = max(TN_{xkj})$	C
TN_N	Min TN	Let TN_n be the daily minimum temperature in month *k*, period *j*. The minimum daily minimum temperature each month is then: $TN_{nkj} = min(TN_{nkj})$	C
FD	Frost days	Let TN be the daily minimum temperature on day *i* in period *j*. Count the number of days where $TN_{ij} < 0C$	Days
ID	Ice days	Let TX be the daily maximum temperature on day *i* in period *j*. Count the number of days where $TX_{ij} < 0C$	Days
SU	Summer days	Let TX be the daily maximum temperature on day *i* in period *j*. Count the number of days where $TX_{ij} > 25C$	Days
TR	Tropical nights	Let TN be the daily minimum temperature on day *i* in period *j*. Count the number of days where $TN_{ij} > 20C$	Days
GSL	Growing season length	Let T be the mean temperature ((TN+TX)/2) on day *i* in period *j*. Count the number of days between the first occurrence of at least 6 consecutive days with T > 5C and the first occurrence after 1st July (NH) or 1st January (SH) of at least 6 consecutive days with $T_{ij} < 5C$	Days
DTR	Diurnal temperature range	Let TN and TX be the daily minimum and maximum temperature respectively on day *I* in period *j*. If *I* represents the number of days in *j*, then: $DTRj = \sum_{n=1}^{I}(TXij - TNij)$	C

Label	Index Name	Index Definition	Units
RX1DAY	Max 1 day precipitation	Let PR_{ij} be the daily precipitation amount on day *i* in period *j*. The maximum 1-day value for period *j* are: $RX1day_j = max (PR_{ij})$	mm
RX5DAY	Max 5 day precipitation	Let PR_{kj} be the precipitation amount for the 5-day interval ending *k*, period *j*. Then maximum 5-day values for period *j* are: $RX5day_j = max (PR_{kj})$	mm
SDII	Simple daily intensity	Let PR_{wj} be the daily precipitation amount on wet days, PR >= 1mm in period *j*. If *W* represents number of wet days in *j*, then: $SDII_j = (\sum_{w=1}^{W} PR_{wj})$	mm
R1MM*	Number of wet days	Let PR_{ij} be the daily precipitation amount on day *i* in period *j*. Count the number of days where PR_{ij} > 1mm	Days
R10MM	Heavy precipitation days	Let PR_{ij} be the daily precipitation amount on day *i* in period *j*. Count the number of days where PR_{ij} > 10mm	Days
R20MM	Very heavy precipitation days	Let PR_{ij} be the daily precipitation amount on day *i* in period *j*. Count the number of days where PR_{ij} > 20mm	Days
CDD	Consecutive dry days	Let PR_{ij} be the daily precipitation amount on day *i* in period *j*. Count the largest number of consecutive days where PR_{ij} < 1mm	Days
CWD	Consecutive wet days	Let PR_{ij} be the daily precipitation amount on day *i* in period *j*. Count the largest number of consecutive days where PR_{ij} > 1mm	Days
R95P	Very wet days	Let PR_{wj} be the daily precipitation amount on a wet day *w* (PR >= 1mm) in period *i* and let $PR_{wn}95$ be the 95th percentile of precipitation on wet days in the 1961–1990 period. If *W* represents the number of wet days in the period, then: $R95p_j = \sum_{w=1}^{W} PR_{wj}$, where $PR_{wj} > PR_{wn}95$	mm
R99P	Extremely wet days	Let PR_{wj} be the daily precipitation amount on a wet day *w* (PR >= 1mm) in period *i* and let $PR_{wn}99$ be the 95th percentile of precipitation on wet days in the 1961–1990 period. If *W* represents the number of wet days in the period, then: $R99p_j = \sum_{w=1}^{W} PR_{wj}$,where $PR_{wj} > PR_{wn}99$	mm
PRCPTOT	Total wet-day precipitation	Let PR_{ij} be the daily precipitation amount on day *i* in period *j*. If I represents the number of days in *j*, then: $PRCPTOTj = \sum_{i=1}^{I} PR_{ij}$	mm

5.1.2.2. Observed Trends in Temperature Extremes Indices

The annual maximum daily minimum (TNx) and maximum daily maximum (TXx) temperatures have increased during the 1961-2014 over the RM. The *CLTS* values of the TNx and TXx on the entire territory of the RM were statistically significant, had a positive sign and varied from +0.4 to +0.6°C /10 years, R^2 was from 15% to 33%, which shows gradual increase in the TNx and TXx during the 1961-2014 years in the region. The value of the determination coefficient, R^2, amounting to 20-33% is higher for the annual maximum daily minimum (TNx) temperature, with *CLTS* from +0.4 to 0.6°C /10 years, which shows a greater statistical significance of changes in TNx on the territory of the RM towards warming, especially in Central and Southern AEZs during period 1961-2014.

Unlike the TNx and TXx, statistically significant changes in annual minimum daily minimum (TNn) and maximum daily minimum (TXn) temperatures are not observed. The upward trend in TNn is observed in Northern and Central by +0.5°C per decade, while for Southern AEZs the trend is higher by +0.6°C per decade, and vice versa the decreasing trend in TXn is observed in Northern (-0.1°C per decade), Central (-0.2°C per decade), and for Southern AEZs, the trend is by -0.01°C per decade, **Figure 5-6, Table 5-4**.

The negative trend statistically significant of diurnal temperature range observed in Northern (-0.09°C per decade) and Central AEZs (-0.14°C per decade) indicates that daily minimum temperature increases with higher magnitude than daily maximum temperature, **Table 5-4.**

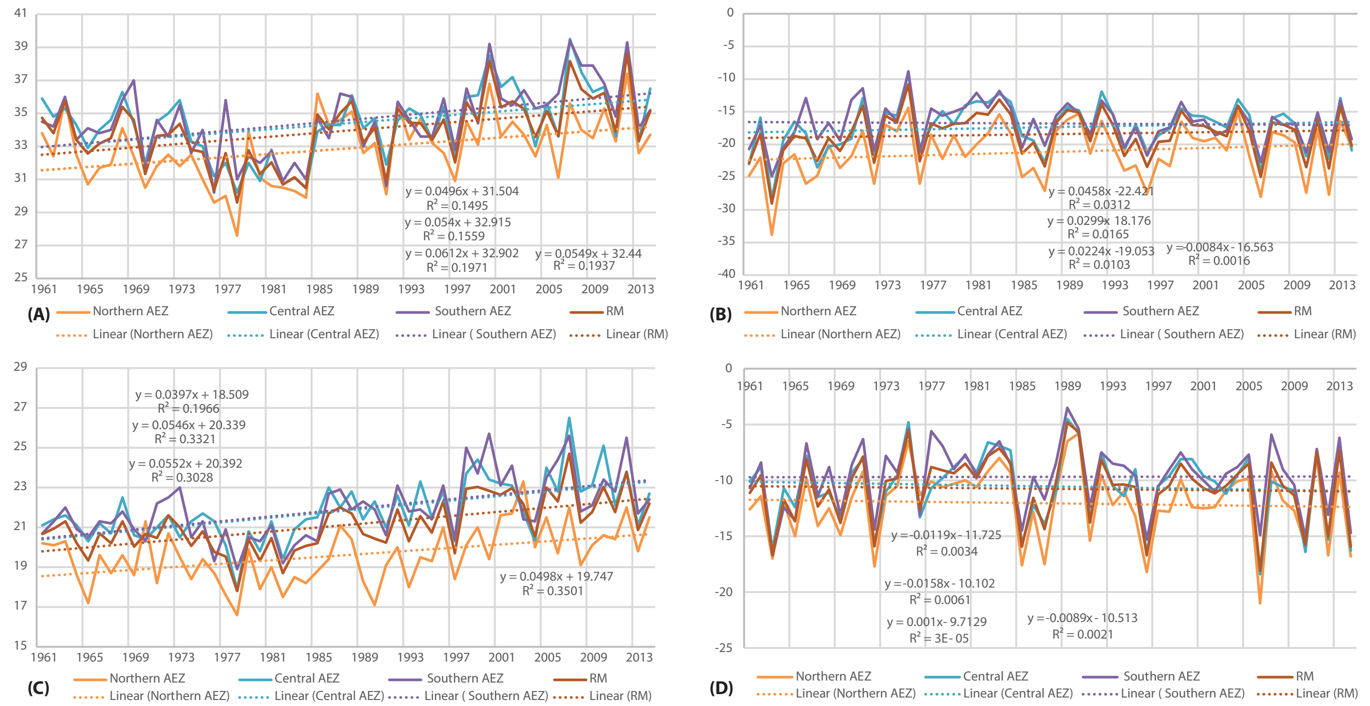


Figure 5-6: Trends in air temperature for 1961-2014: (A) Maximum daily maximum temperature (TXx), (B) Minimum daily minimum temperature (TNn), (C) Minimum daily maximum temperature (TXn), (D) Maximum daily minimum temperature (TNx).

Table 5-4: The Minimum Daily Minimum Temperature (TNn), Maximum Daily Maximum Temperature (TXx), Maximum Daily Minimum Temperature (TNx), Minimum Daily Maximum Temperature (TXn), °C, Trend Slope (°C /10 Years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p -value*, for 1961-2014

Extreme Indices	Northern AEZ				Central AEZ				Southern AEZ			
	Mean	*Trend*	R^2	*p*	*Mean*	*Trend*	R^2	*p*	*Mean*	*Trend*	R^2	*p*
TNn	-21.2	+0.5	3	0.2010	-17.4	+0.3	2	0.3548	-16.8	+0.2	0.1	0.7713
TXx	32.9	+0.5	15	**0.0039**	34.4	+0.5	16	**0.0031**	34.6	+0.6	20	**0.0008**
TNx	19.6	+0.4	20	**0.0007**	21.8	+0.5	33	**0.0000**	21.9	+0.6	30	**0.0000**
TXn	-12.1	-0.1	0.3	0.6756	-10.5	-0.2	0.6	0.5753	-9.7	-0.01	0.0	0.9699
DTR	8.8	-0.09	7	**0.0509**	8.5	-0.14	14	**0.0061**	8.8	+0.04	1	0.4307

Consistent changes are found in the temperature threshold indices; specifically, these indices are frost days (FD) and tropical nights (TN), which are derived from daily minimum temperature, and ice days (ID) and summer days (SU), are derived from daily maximum temperature, **Figure 5-7**.

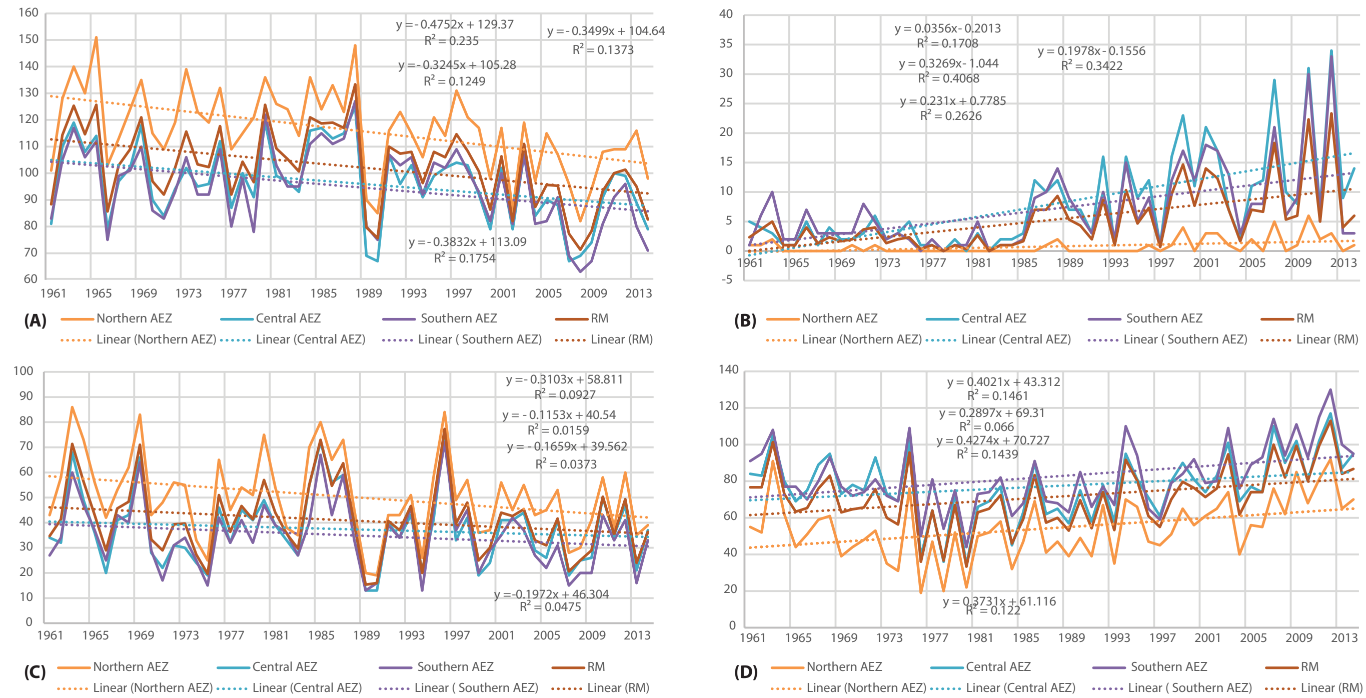


Figure 5-7: Trends in: (A) Frost Days (FD), (B) Tropical Nights (TR), (C) Ice Days (ID), (D) Summer Days (SD) for 1961-2014.

During the 1961-2014, have observed decreases in frost days, FD and ice days, ID over the RM. The *CLTS* values of the FD on the entire territory of the RM were statistically significant, had a negative sign and varied from -3.2 (Central AEZ) to -4.7 (Northern AEZ) days /10 years, R^2 was from 12% to 24%, which shows a gradual decrease in the FD in the region. The value of the determination coefficient, R^2, amounting to 2-9% is considerably lower for the ID, with *CLTS* by -3.1 days /10 years, which shows a statistical significance of changes only in Northern AEZ. The decreasing trend in ID was observed in Central (-1.1/10 years), and Southern AEZs (-1.7/10 years), statistical not significant, **Table 5-5; Figure 5-7**.

Table 5-5: Temperature Extreme Indices, (Days), the Trend Slope (Days/10 Years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value*, for 1961-2014

Extreme Indices	Northern AEZ				Central AEZ				Southern AEZ			
	Mean	*Trend*	R^2	*p*	*Mean*	*Trend*	R^2	*p*	*Mean*	*Trend*	R^2	*p*
CSDI	3	-0.21	4	0.1314	4	-0.04	0.0	0.9314	5	-0.02	0.0	0.9702
FD	116	-4.7	24	**0.0002**	96	-3.2	12	**0.0087**	95	-3.5	14	0.0058
ID	50	-3.1	9	**0.0251**	37	-1.1	2	0.3641	35	-1.7	4	0.1620
SU	54	+4.0	15	**0.0043**	77	+2.9	7	**0.0607**	82	+4.3	14	**0.0046**
TR	1	+3.5	17	**0.0019**	8	+3.6	41	**0.0000**	7	+2.3	26	**0.0000**

The increasing trend in tropical nights, TR and summer days, SU have observed during the 1961-2014 over the RM. The *CLTS* values of the TR on the entire territory of the RM were statistically significant, had a positive sign and varied from +3.5 (Northern AEZ) to +2.3 (Southern AEZ), with maximum +3.6 (Central AEZ) days/10 years, R^2 was from 17 to 41%, which shows a gradual increase in the TR in the region. The value of the determination coefficient, R^2, amounting to 7-15% is considerably lower for the SU, with increasing *CLTS* from +4.0 to +4.3 days/10 years, statistical significant in Northern and Southern AEZs, **Table 5-5; Figure 5-7**.

Observed changes of cold nights (TN10p) and cold days (TX10p), warm nights (TN90p) and warm days (TX90p) are shown in **Figure 5-8**. Consisting with warming and observed trends of absolute and threshold temperature indices a decrease in TN10p and TX10p have observed during the 1961-2014 over the RM. The *CLTS* values of the TN10p on the entire territory of the RM were statistically significant, had a negative sign and varied from -1.7 (Northern AEZ) to -1.0 % /10 years (Southern AEZ), R^2 was from 17% to 43%, which shows a gradual decrease in the cold nights in the region. The value of the determination coefficient, R^2, amounting to 3-9% was considerably lower for cold days (TX10p), with *CLTS* by -0.8 %/10 years, which shows a statistical significance of changes only in Northern AEZ. The decreasing trend, statistical not significant in TX10p was observed in Central (-0.5 % /10 years), and in Southern AEZs (-0.6 % /10 years), **Table 5-6; Figure 5-8**.

The warm nights (TN90p) and warm days (TX90p) have increased during the 1961-2014 over the RM. The *CLTS* values of the TN90p and TX90p on the entire territory of the RM were statistically significant, had a positive sign and varied from +2.4%/10 years (Northern AEZ) to +2.0 (Southern AEZ), with maximum +2.6 %/10 years (Central AEZs) and from +1.0 (Central AEZ) to +1.6 %/10 years (Northern and Southern AEZs). Coefficient of Determination, R^2 was from 35 to 49% and from 9 to 22%, respectively, that shows consistent increase in the TNx and TXx during the 1961-2014 time period in the region. The value of the determination coefficient, R^2, amounting to 35-49%, was higher for the warm nights (TN90p), with *CLTS* from +2.0 to +2.6 %/10 years, which shows a greater statistical significance of changes in TN90p on the territory of the RM towards warming, especially in Northern and Central AEZs during the 1961-2014 time period, **Table 5-6; Figure 5-8**.

Table 5-6: Temperature Extreme Indices, (%), the Trend Slope (%/10 Years), Coefficient of Determination, R^2 and Statistical Significance of Changes , *p -value*, for 1961-2014.

Extreme Indices	Northern AEZ				Central AEZ				Southern AEZ			
	Mean	*Trend*	R^2	*p*	*Mean*	*Trend*	R^2	*p*	*Mean*	*Trend*	R^2	*p*
TN10p	8.2	-1.7	43	**0.0000**	8.7	-1.6	35	**0.0000**	9.4	-1.0	17	**0.0020**
TX10p	9.5	-0.8	9	**0.0240**	9.7	-0.5	3	0.1889	9.8	-0.6	4	0.1451
TN90p	13.8	+2.4	49	**0.0000**	14.1	+2.6	47	**0.0000**	13.3	+2.0	35	**0.0000**
TX90p	12.6	+1.6	22	**0.0004**	12.4	+1.0	9	**0.0251**	12.9	+1.6	20	**0.0008**

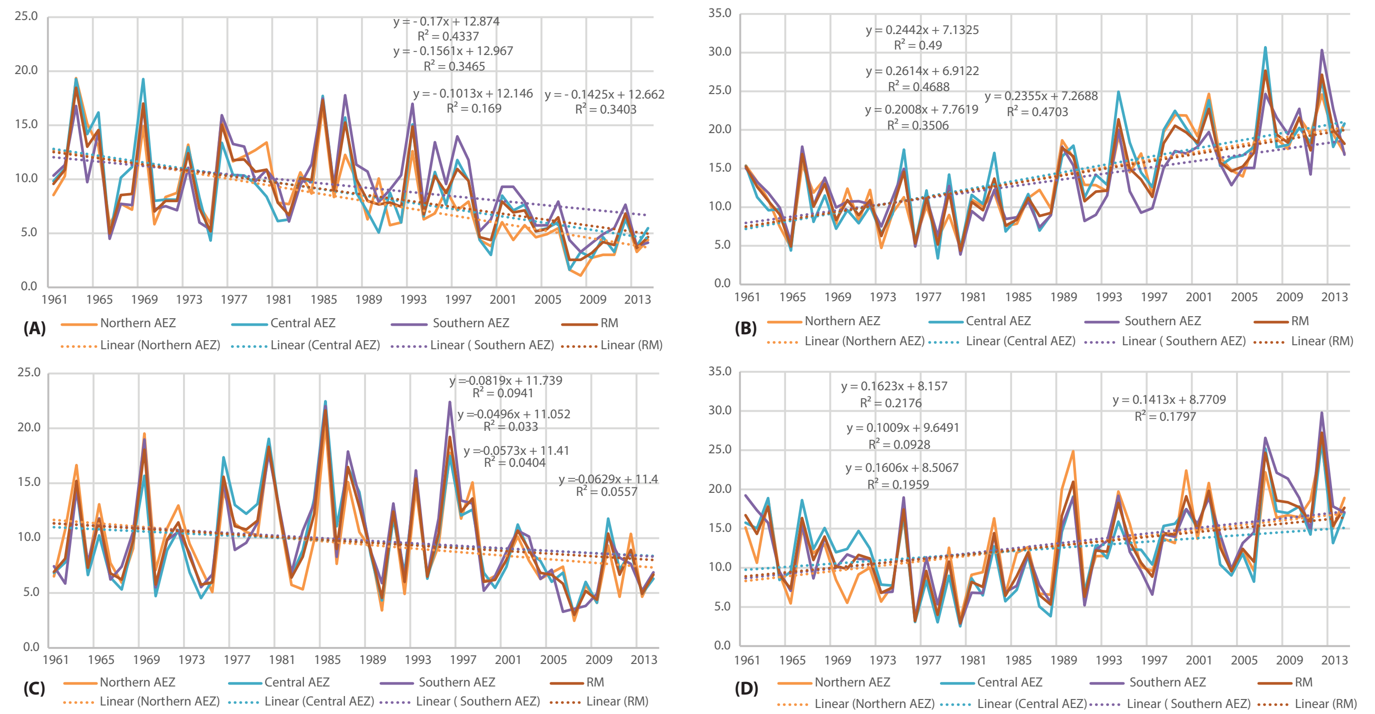


Figure 5-8: Trends in: (A) Cold Nights (TN10p), (B) Warm Nights (TN90p), (C) Cold Days (TX10p), (D) Warm Days (TX90p) for 1961-2014.

Trends in temperature-based percentile indices cold nights (TN10p), cold days (TX10p), warm nights (TN90p) and warm days (TX90p) were compared to examine the consistence in the magnitude of change across the Republic of Moldova in 1961-2014 years. The linear regression slope, fitted to the combined change rates of annual cold nights against warm nights are -0.96% per year, while cold days versus warm days are -0.67% per year, **Figure 5-9 (a, b).** According to these ratios, it is clear that the increased frequency of annual warm nights is greater than the decrease in cold nights across the Republic of Moldova, and the frequency of annual warm days increases faster than the decrease rate of the annual cold days. Furthermore, the slope of linear regression from the annual cold days versus cold nights is +0.69% per year, while the slope of warm days against warm nights is +0.91% per year, **Figure 5-9 (c, d)**. These slopes suggest that annual extreme temperature change is more obvious in night events than in daytime ones, thus reinforcing the earlier findings (Alexander, et al., 2006).

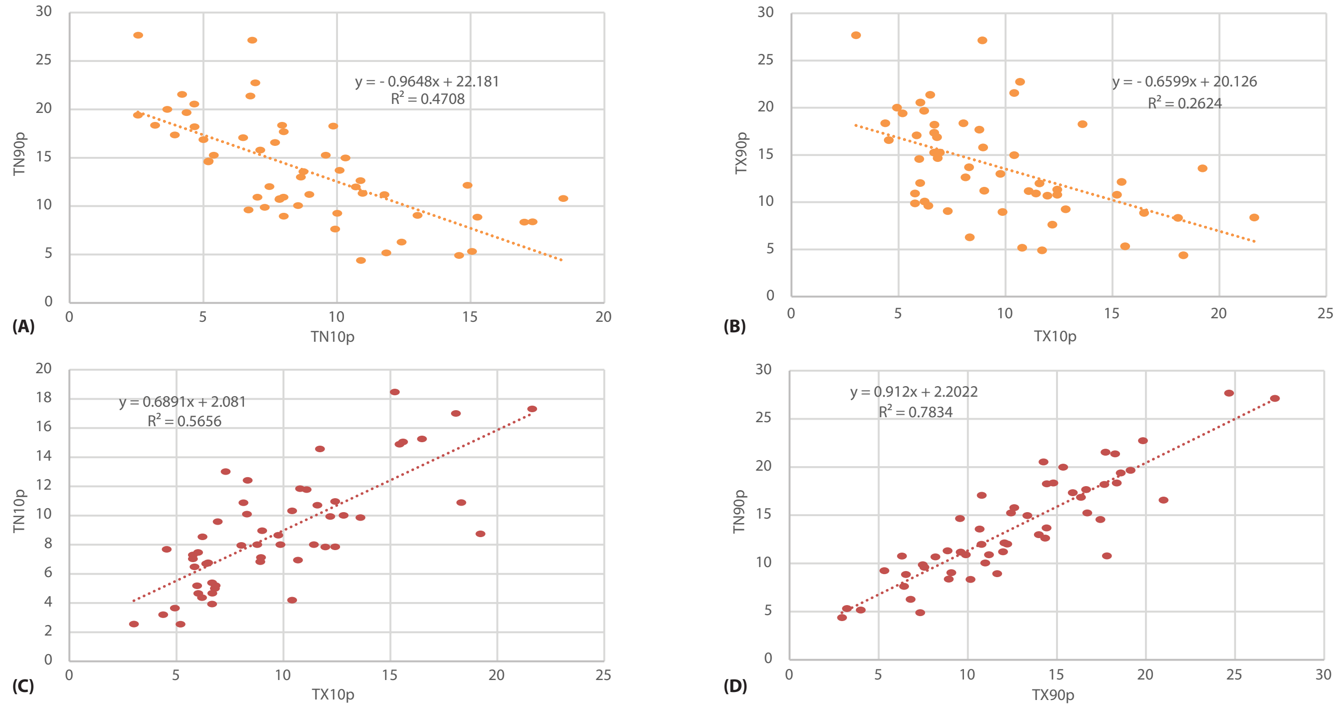


Figure 5-9: Comparisons of trends for temperature-based percentile indices Cold Nights (TN10p), Cold Days (TX10p), Warm Nights (TN90p) and Warm Days (TX90p) over 1961-2014 across the Republic of Moldova.

5.1.2.3. Observed Trends in Precipitation Extremes Indices

Annual precipitation records averaged across Europe show no significant changes since 1950 according to the E-OBS dataset (Haylock et al., 2008), based on the European Climate Assessment dataset (Klok and Klein Tank, 2009). At the sub-continental scale, the trend in precipitation is most significant in North-Eastern and South-Western Europe. In most of Scandinavia and the Baltic States an increase in annual precipitation of greater than 14 mm per decade was observed, with an increase of up to 70 mm per decade in Western Norway. In contrast, annual precipitation has decreased in the Iberian Peninsula, in particular in North-Western Spain and in Northern Portugal, **Figure 5-10**.

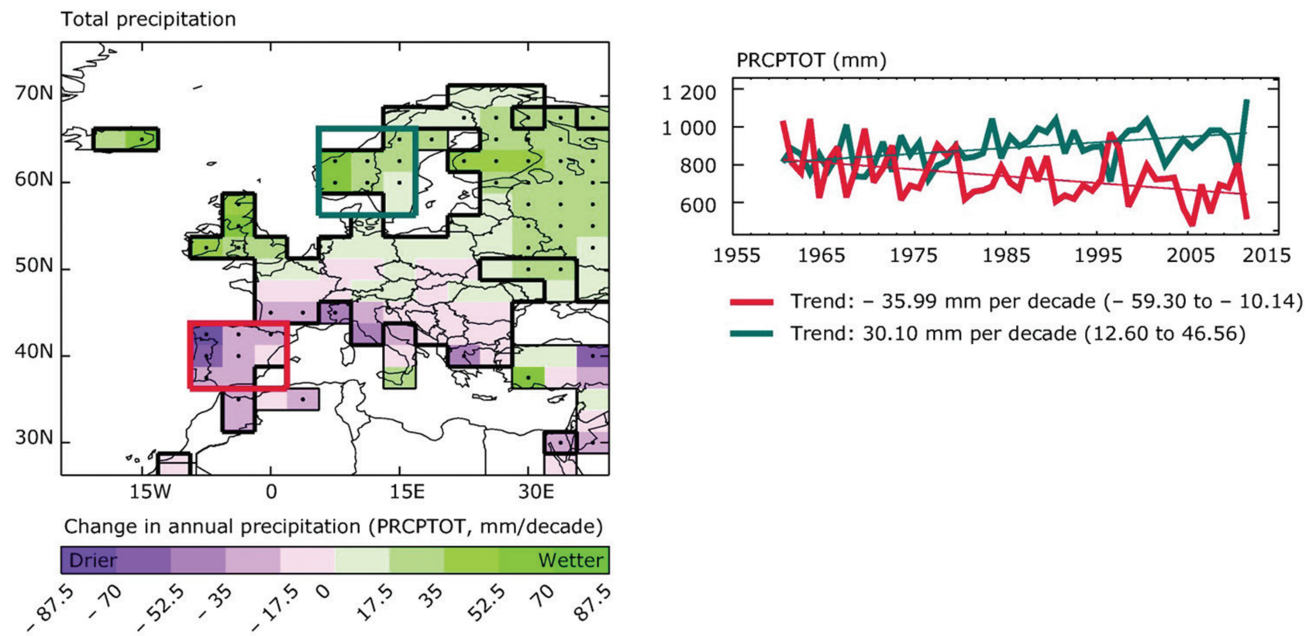


Figure 5-10: Trends in annual precipitation across Europe (1960–2012).

Note: The trends are calculated using a median of pairwise slopes algorithm. Black dots represent high confidence in the sign of the long-term trend in the box (if the 5th to 95th percentile slopes are of the same sign). Boxes which have a thick outline contain at least three stations. Area averaged annual time series of percentage changes and trend lines are shown below each map for one area in Northern Europe (blue line, 5.6 to 16.9°E and 56.2 to 66.2°N) and one in South-Western Europe (red line, 35.6 to 1.9°E and 36.2 to 43.7 °N).

Source: HadEX dataset, updated with data from the ECA&D dataset, EEA 2012.

While there is some evidence linking land use, in particular forest cover, to local and regional precipitation patterns (Millán, 2008), it is not clear if the relatively minor land-use changes since 1950 have influenced the observed precipitation trends.

The indices of extreme precipitation values were calculated based on the daily observations data of precipitation for the period from 1961 to 2010. Climate scientists have identified a set of 27 core indices for analyzing daily data of temperature and precipitation (Karl et al., 1999; Peterson T.C and et. al., 2001, 2005; Alexander et al., 2006). The definitions for a core set of 27 descriptive indices of extremes defined by the Joint CCl / CLIVAR / JCOMM Expert Team on Climate Change Detection and Indices (ETCCDI, see <http://www.clivar.org/organization/etccdi/etccdi.php>).

From the list of climate change indices, for the purpose of the analysis the precipitation extremes, nine precipitation indices were determined (**Table 5-7**).

Table 5-7: The definitions of precipitation extreme indices have been used in the assessment

Indices	Abbreviation	Definition and calculation	Unit
Annual total wet day precipitation	**PRCPTOT**	Annual total precipitation from days ≥ 1mm. Let RR*wj* be the daily precipitation amount on a wet day *w* (RR ≥ 1 mm) in period *j*. Then PRCPTOT*j* = sum (RR*wj*).	mm
Contribution from very wet days	**R95pTOT%**	100 * R95pTOT/PRCPTOT. Let RRwj be the daily precipitation amount on a wet day w (RR ≥ 1 mm) in period j and let RRwn95 be the 95th percentile of precipitation on wet days in the base period n (1961-1990). Then R95pTOTj = sum (RRwj), where RRwj > RRwn95.	%
Contribution from extremely wet days	**R99pTOT%**	100 * R99pTOT / PRCPTOT. Let RRwj be the daily precipitation amount on a wet day w (RR ≥ 1 mm) in period j and let RRwn99 be the 99th percentile of precipitation on wet days in the base period n (1961-1990). Then R99pTOTj = sum (RRwj), where RRwj > RRwn99.	%
Maximum one-day precipitation	**RX1day**	Monthly maximum 1-day precipitation. Let RR*ij* be the daily precipitation amount on day *i* in period *j*. The maximum one-day value for period *j* is RX1day*j* = max (RR*ij*).	mm
Simple daily intensity index	**SDII**	The ratio of annual total precipitation to the number of wet days (≥ 1 mm). Let RR*ij* be the daily precipitation amount on wet day *w* (RR ≥ 1 mm) in period *j*.	mm / day
Number of heavy precipitation days	**R10mm**	Annual count when precipitation ≥10mm. Let RR*ij* be the daily precipitation amount on day *i* in period *j*. Count the number of days where RR*ij* ≥ 10 mm.	Days
Number of very heavy precipitation days	**R20mm**	Annual count when precipitation ≥ 20mm. Count of days where RR ≥ 20 mm Let RR*ij* be the daily precipitation amount on day *i* in period *j*. Count the number of days where RR*ij* ≥ 20 mm.	Days
Consecutive dry days	**CDD**	Maximum number of consecutive days when precipitation<1mm. Let RR*ij* be the daily precipitation amount on day *i* in period *j*. Count the largest number of consecutive days where RR*ij* < 1 mm.	Days
Consecutive wet days	**CWD**	Maximum number of consecutive days when precipitation ≥ 1mm. Let RR*ij* be the daily precipitation amount on day *i* in period *j*. Count the largest number of consecutive days where RR*ij* ≥ 1 mm.	Days

Precipitation extremes indices were calculated according to Klein Tank et al., 2009; including contribution from very wet days (R95pTOT), and contribution from extremely wet days (R99pTOT), due to their potential to have significant societal impacts (Donat M.G. et al., 2013).

In applications of statistics to climatology, such as the estimation of moments of statistical distributions, analysis of trends, correlation analysis, etc., parametric methods are commonly utilized. Their correct use requires several assumptions to be fulfilled, including the type of distribution (most frequently normal), serial independence (i.e. zero autocorrelation), and stationarity.

The estimate of trend by the least-squares regression for climatic element *yi* and time variable (years) *xi, i* =1; . . . ; n, was used the well-known form:

$$b = \frac{n\sum_1^n x_i y_i - \sum_1^n x_i \sum_1^n y_i}{n\sum_1^n (x_i)^2 - \sum_1^n (x_i)^2}$$

and its confidence interval, assuming normality of the distribution, expressed as:

$$b = \mp \frac{t_{(1+p)/2}\sigma_E}{n^{1/2} S_x}$$

where $t_{(1+p)/2}$ is the (1+p)/2 quantile of the distribution, is the standard deviation of residuals, and is the standard deviation of (Wilks, 1995; von Storch and Zwiers, 1999).

Non-parametric (distribution-free) methods, which relax the assumptions, may serve as an alternative. They tend to be more resistant to a misbehavior of the data (e.g. to outliers) than the parametric methods, at the expense of being less efficient, that is, they have larger uncertainty in the statistical estimate. An introductory review of non-parametric statistical methods applicable in climatology has been provided by Lanzante (1996).

The non-parametric Mann-Kendall (M-K) test is widely used for detecting trends in hydrological and meteorological parameters (e.g., Huth and Pokorná; Modarres and da Silva, 2007; Wang et al., 2008; Mishra and Singh, 2010; Zhang et al., 2011; EEA, 2012; Donat et al., 2013). The test does not require the data to be distributed normally. Further, the test has a low sensitivity to abrupt breaks in the time series (Jaagus, 2006), and can test trends in a time series without requiring normality or linearity (Wang et al., 2008).

For non–parametric estimate was used an Excel template – MAKESENS – developed for detecting and estimating trends in the time series of annual values of atmospheric and precipitation concentrations. The procedure is based on the nonparametric Mann-Kendall test for the trend and the nonparametric Sen's method for the magnitude of the trend. The Mann-Kendall test is applicable to the detection of a monotonic trend of a time series with no seasonal or other cycle. The Sen's method uses a linear model for the trend (Salmi et al., 2002).

The patterns of recent changes in precipitation indices appear spatially more heterogeneous across the Republic of Moldova than the consistent warming pattern seen in the temperature indices. Observational records of most of the precipitation extreme indices do not indicate significant trends in case of parametric as well as non-parametric (distribution-free) estimations across the Republic of Moldova. Some changes in these variables have been observed across the Republic of Moldova's AEZs but most of them are not statistically significant due to large natural variability. Most of the precipitation indices show changes toward more intense precipitation over northern and central AEZs. Such changes in extreme precipitation are found, for example, for the average intensity of daily precipitation (SDII), number of heavy (R10mm) and very heavy precipitation days (R20mm) (see **Figure 5-11:** blue and red trend lines; and **Table 5-8**). All indices display upward trends during the past 50 years. Similar patterns of change are also found for the annual total precipitation in wet days (PRCPTOT) and contribution from very wet days (R95pTOT) and extremely wet days (R99pTOT), (see **Figure 5-11:** blue and red trend lines; and **Table 5-8**).

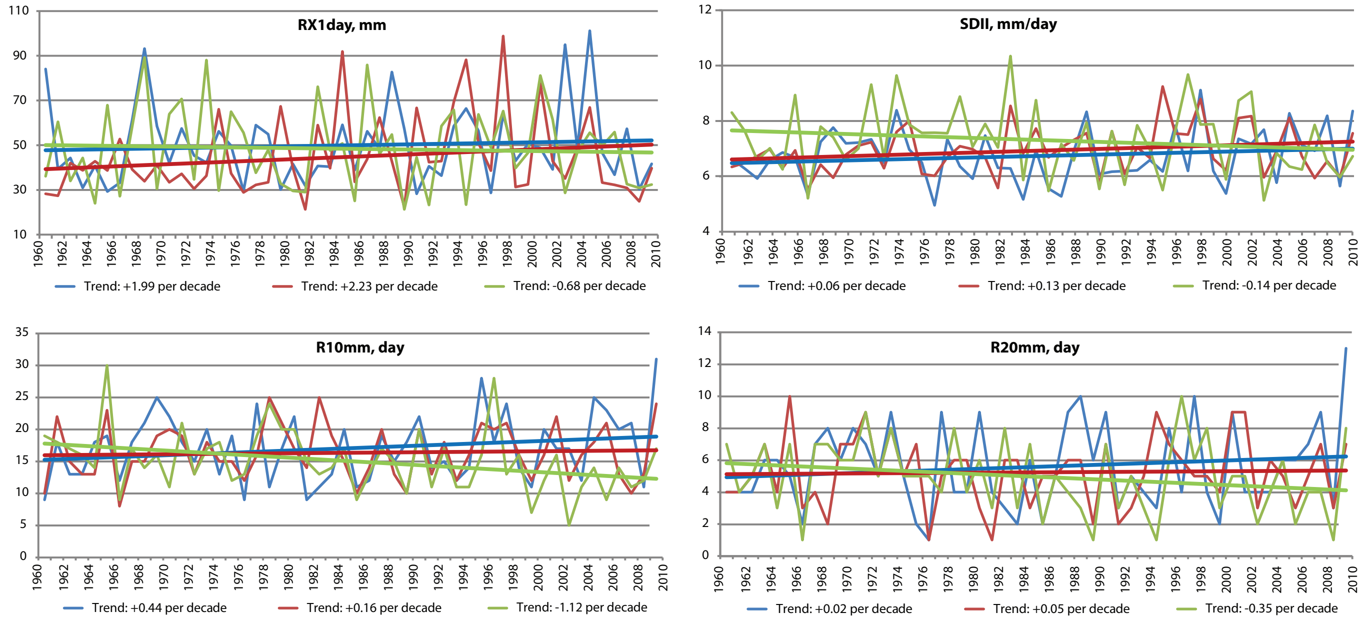


Figure 5-11: Trends in maximum one-day precipitation (RX1day), simple daily intensity index (SDII), heavy precipitation days (R10mm), and very heavy precipitation days (R20mm): blue line – Northern AEZ, red line – Central AEZ and green line – Southern AEZ (1961–2010).

All precipitation-based indices show larger areas with not significant trends toward wetter conditions than areas with drying trends. In southern AEZ have been observed not significant trends toward less frequent and intense precipitation, except for contribution from extremely wet days (R99pTOT) (see **Figures 5-11** and **5-12:** green trend line; and **Table 5-8**).

Table 5-8: Mann – Kendall Test (Z) of Precipitation Extreme Indices

AEZ	RX1day	SDII	R10mm	R20mm	PRCPTOT	R95pTOT	R99pTOT	CDD	CWD
Northern	0.33	0.64	1.18	0.69	0.59	0.92	0.60	-1.01	0.40
Central	0.90	1.32	0.34	0.25	0.55	0.85	0.42	-1.20	-0.36
Southern	-0.36	-1.04	-2.61**	-1.87+	-1.50	0.15	0.46	0.53	-1.81+

Note: The presence of a statistically significant trend is evaluated using the *Z* value. A positive (negative) value of *Z* indicates an upward (downward) trend. In this research, significance levels of α = 0.001***, 0.01** and 0.05*, α = 0.1+ were applied.

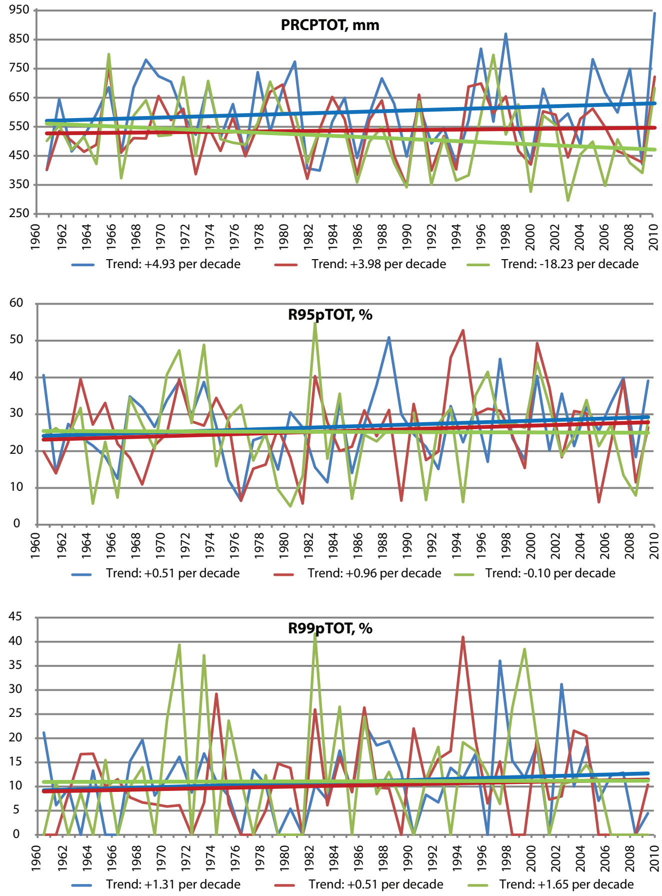


Figure 5-12: Trends in total precipitation in wet days (PRCPTOT), precipitation due to very wet days (R95pTOT, %) and precipitation due to extremely wet days (R99pTOT, %): blue line – Northern AEZ, red line – Central AEZ and green line – Southern AEZ (1961–2010).

Observational records do not indicate widespread significant trends in either the number of consecutive wet days (indicating flood risks) or dry days (indicating drought risks) across Europe (**Figure 5-13**).

Some changes in these variables have been observed across Europe, but most of them are not statistically significant due to large natural variability. Interestingly, parts of North-Western and North-Eastern Europe show significant increasing trend in both the number of wet days and dry days. The proportion of Europe that has experienced extreme or moderate meteorological drought conditions did not change significantly during the 20th century (Lloyd-Hughes and Saunders, 2002). Summer droughts have also shown no statistically significant trend during the period 1901–2002 (Robock et al., 2005).

Observational records do not indicate significant trends in either the number of dry days (indicating drought risks) or consecutive wet days (indicating flood risks) in case of parametric as well as non-parametric (distribution-free) estimations across Republic of Moldova. Some changes in these variables have been observed across Republic of Moldova's AEZs but neither of them are statistically significant due to large natural variability. According to parametric as well as non-parametric (distribution-free) estimations, central AEZ reveals decreasing trends, not statistically significant, in both the number of wet days and dry days, also, in southern AEZ have been observed not statistically significant trends toward increasing trends in the number of dry days (indicating drought risks) and decreasing in the number of wet days (indicating flood risks). According to non-parametric (distribution-free) estimations in Northern AEZ no statistically significant trends toward increasing in the number of wet days (indicating flood risks), and decreasing in the number of dry days were observed (see **Table 5-8** and **Figure 5-14**).

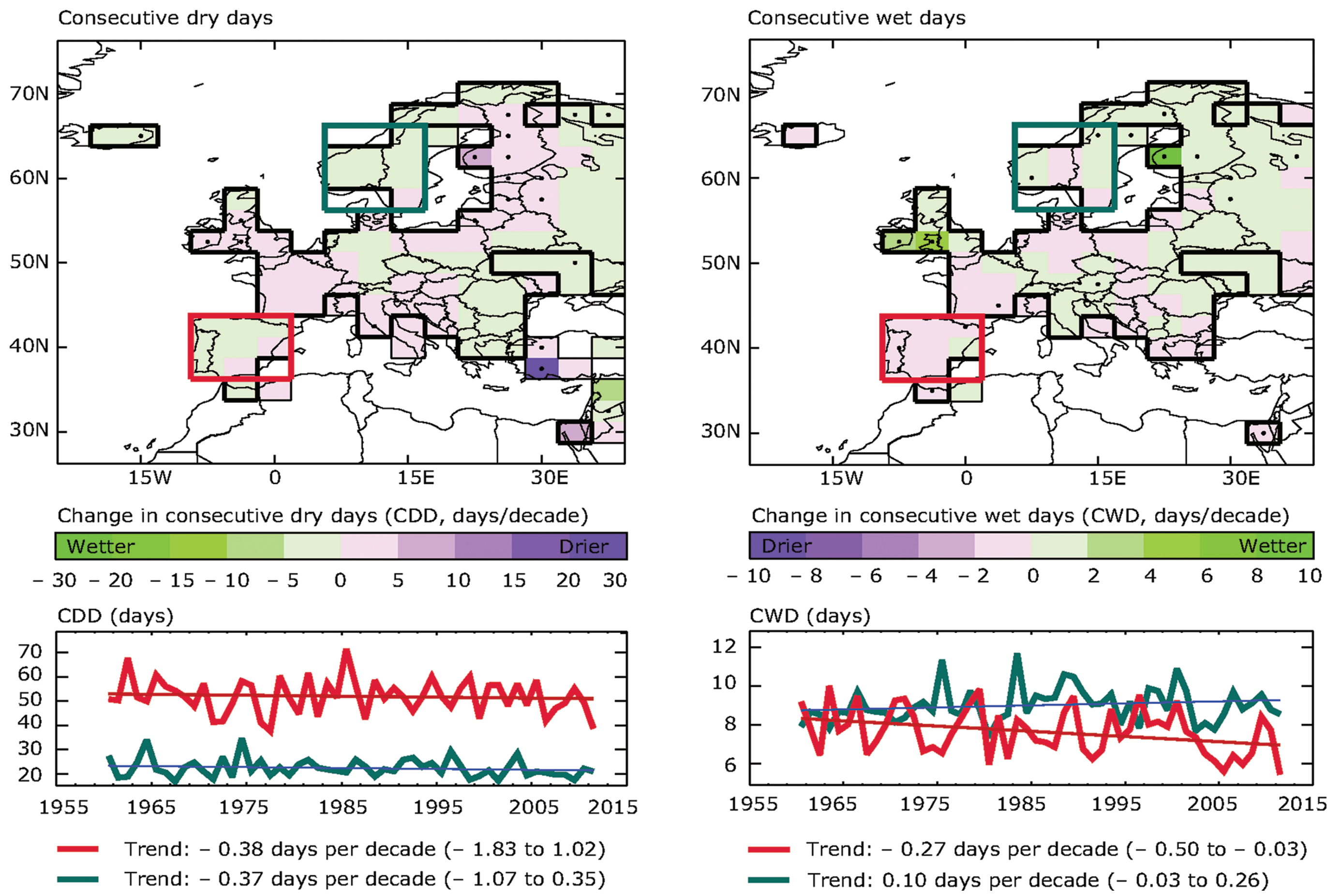


Figure 5-13: Trends in consecutive dry and consecutive wet days (1960-2012).

Note: High confidence in a long-term trend is shown by a black dot (if the 5th to 95th percentile slopes are of the same sign). Boxes which have a thick outline contain at least three stations. Area averaged annual time series of percentage changes and trend lines are shown below each map for one area in Northern Europe (blue line, 5.6 to 16.9 °E and 56.2 to 66.2 °N) and one in South-western Europe (red line, 35.6 - to 1.9°E and 36.2 to 43.7°N).

Source: HadEX dataset, updated with data from the ECA&D dataset, EEA, 2012.

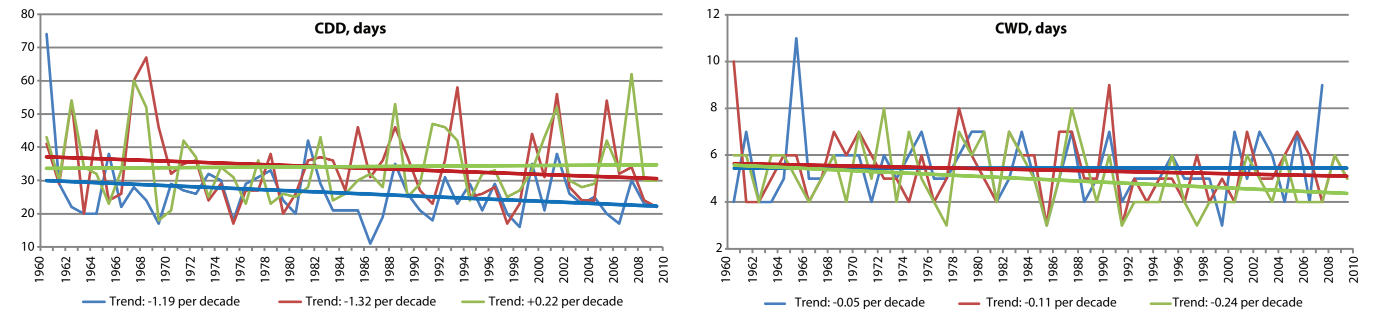


Figure 5-14: Trends in consecutive dry days (CDD) and consecutive wet days (CWD): blue line – Northern AEZ, red line – Central AEZ and green line – Southern AEZ (1961–2010).

5.2. Climate Change Scenarios for XXI Century in the Republic of Moldova According to the CMIP5 Ensemble of 21 GCMs

Studies undertaken to date for developing regional GCM-based scenarios in the Republic of Moldova have used the 30-year period 1961 to 1990 as a climatologic baseline, and have studied the influence of climate change on relevant sectors within three time horizons: 2010-2039, 2040-2069 and 2070-2099. Three individual Coupled Atmosphere-Ocean General Circulation Models (GCMs) based on IS92a scenario were used for the vulnerability and adaptation assessments in First and Second National Communications of the Republic of Moldova under the UNFCCC [FNC, 2000; SNC, 2010] as described in the Intergovernmental Panel on Climate Change (IPCC) Second Assessment Report. The 2009/2010 NHDR for the Republic of Moldova [NHDR, 2010] uses the experiments of an ensemble of six GCM experiments based on the SRES A2 and B2 scenarios for downscaling climate projections for the Republic of Moldova as recommended by IPCC Third Assessment Report (TAR). The multi-model ensemble of the 10 GCMs simulations introduced by three SRES emission scenarios A2, A1B and B1 as recommended by IPCC Fourth Assessment Report (AR4) covering the end of 20th (reference period) and 21st (scenario) centuries were used for the vulnerability and adaptation assessments in Third National Communications of the RM under the UNFCCC [TNC, 2014].

The objective of this study was developing new regional climate projections and analysing the possible changes over RM's Northern, Central and Southern Agro-Ecological Zones (AEZs) in terms of the distribution of temperature and precipitation, based on new CMIP5 multi-model ensemble of 21 GCMs, introduced by three Representative Concentration Pathways (RCPs): RCP8.5, RCP4.5 and RCP 2.6as recommended by IPCC (AR5), covering the end of 20^{th} (reference period) and 21^{st} (scenario) centuries.

5.2.1. Data and Methods

The model simulations for precipitation and temperature used in this report stem from 21 of the global coupled atmosphere ocean general circulation models (AOGCMs) made kindly available by the WCRP Coupled Model Intercomparison Project – Phase 5 (CMIP5) [the CMIP5 multi-model ensemble [archive/output/results/of simulations/dataset/ ...] CLIVAR Exchanges Newsletter, 2011; Taylor, et al., 2012, Hibbard et al., 2007; Meehl, et al 2007 (see **Table 5-9**).

Table 5-9: The CMIP5 models used in this study for each of the historical and RCP scenario experiments

Modelling Centre or Group	Institute ID	Model Name
Beijing Climate Centre, China Meteorological Administration	BCC	BCC-CSM1.1 BCC-CSM1.1(m)
College of Global Change and Earth System Science, Beijing Normal University	GCESS	BNU-ESM
Canadian Centre for Climate Modelling and Analysis	CCCMA	CanESM2
National Centre for Atmospheric Research	NCAR	CCSM4
Community Earth System Model Contributors	NSF-DOENCAR	CESM1(CAM5)
Centre National de Recherches Météorologiques / Centre Européen de Recherche et Formation Avancée en Calcul Scientifique	CNRM-CERFACS	CNRM-CM5
Commonwealth Scientific and Industrial Research Organization in collaboration with Queensland Climate Change Centre of Excellence	CSIRO-QCCCE	CSIRO-Mk3.6.0
EC-EARTH consortium	EC-EARTH	EC-EARTH
NOAA Geophysical Fluid Dynamics Laboratory GFDL-ESM2G	NOAA	GFDL-CM2G
NASA Goddard Institute for Space Studies	NASA	GISS-E2-H GISS-E2-R
National Institute of Meteorological Research/Korea Meteorological Administration	NIMR/KMA	HadGEM2-AO
Met Office Hadley Centre (additional HadGEM2-ES realizations contributed by Instituto Nacional de Pesquisas Espaciais)	MOHC (additional realizations by INPE)	HadGEM2-ES
Institute Pierre-Simon Laplace	IPSL	IPSL-CM5A-LR IPSL-CM5A-MR
Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology	MIROC	MIROC5
Max Planck Institute for Meteorology	MPI-M	MPI-ESM-LR MPI-ESM-MR
Meteorological Research Institute	MRI	MRI-CGCM3
Norwegian Climate Centre	NCC	NorESM1-M

Note: *"We acknowledge the World Climate Research Programme's Working Group on Coupled Modelling, which is responsible for CMIP, and we thank the climate modelling groups (listed in Table 5- of this study) for producing and making available their model output. For CMIP the U.S. Department of Energy's Program for Climate Model Diagnosis and Intercomparison provides coordinating support and led development of software infrastructure in partnership with the Global Organization for Earth System Science Portals."*

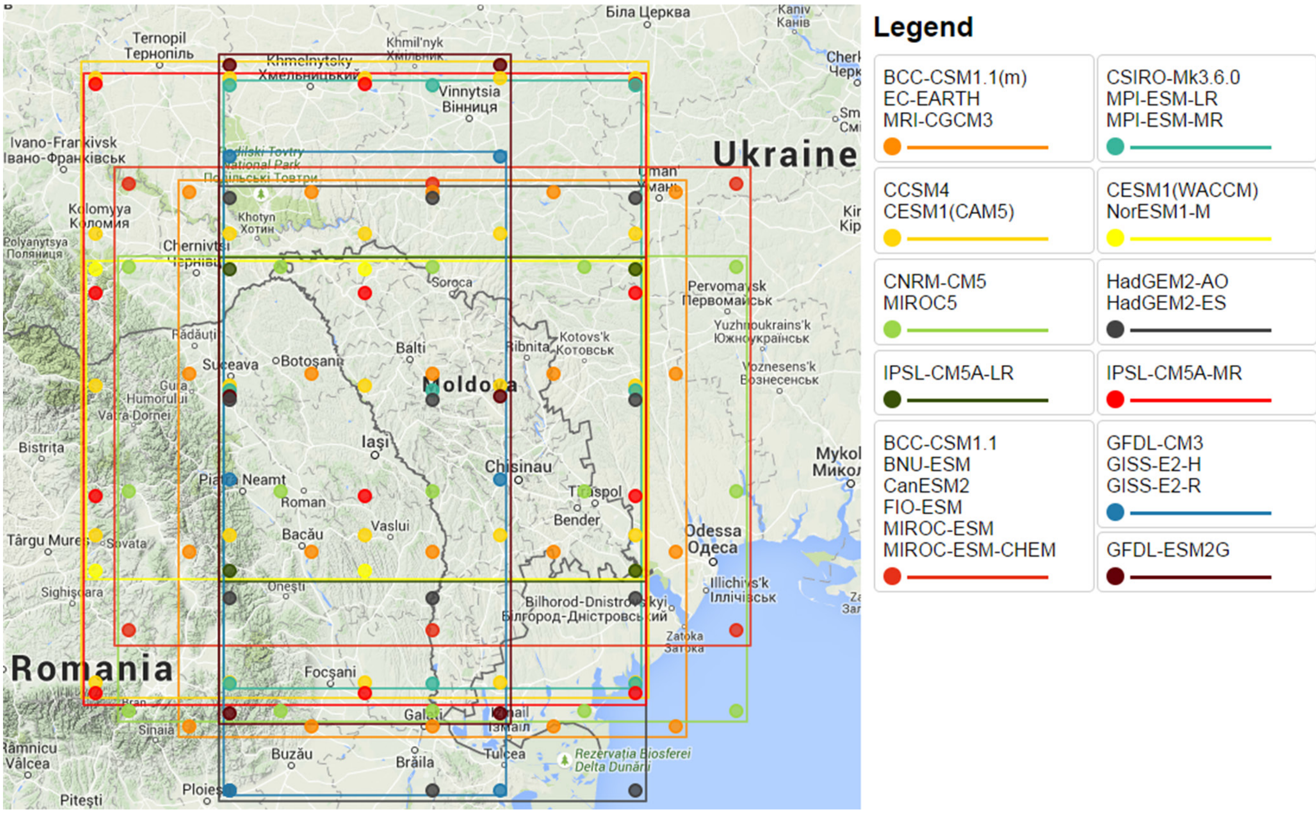


Figure 5-15: The Number of Grid Points and Corresponding AOGCM Climate Prediction Area (Frame) for the Territory of the Republic of Moldova.

A new parallel process for scenario development was proposed in order to facilitate the interactions between the scientific communities working on climate change, adaptation and mitigation (Hibbard et al., 2007; Moss et al., 2008, 2010; van Vuuren et al., 2011). These new scenarios, Representative Concentration Pathways, are referred to as pathways in order to emphasize that they are not definitive scenarios, but rather internally consistent sets of time-dependent forcing projections that could potentially be realized with more than one underlying socioeconomic scenario.

The primary products of the RCPs are concentrations but they also provide gas emissions. They are representative in that they are one of several different scenarios, sampling the full range of published scenarios (including mitigation scenarios) at the time they were defined that have similar RF and emissions characteristics. They are identified by the approximate value of the RF[176] (in W m^{-2}) at 2100 or at stabilization after 2100 in their extensions, relative to pre-industrial (Moss et al., 2008; Meinshausen et al., 2011c). RCP2.6 (the lowest of the four, also referred to as RCP3-PD) peaks at 3.0 W m^{-2} and then declines to 2.6 W m^{-2} in 2100. RCP4.5 (medium-low) and RCP6.0 (medium-high) stabilize after 2100 at 4.2 and 6.0 W m^{-2} respectively, while RCP8.5 (highest) reaches 8.3 W m^{-2} in 2100 on a rising trajectory (see Figure 5-16 which takes into account the efficacies of the various anthropogenic forcing).

The primary objective of these scenarios is to provide all the input variables necessary to run comprehensive climate models in order to reach a target RF. These scenarios were developed using IAMs that provide the time evolution of a large ensemble of anthropogenic forcing (concentration and emission of gas and aerosols, land use changes, etc.) and their individual RF values (Moss et al., 2008, 2010; van Vuuren et al., 2011) and ENSEMBLES multi-model results for SRES A1B and E1 scenarios (Johns et al., 2011).

Comparison of Special Report on Emission Scenarios and Representative Concentration Pathway Scenarios

The four RCP scenarios used in CMIP5 lead to RF values that range from 2.3 to 8.0 W m^{-2} at 2100, a wider range than that of the three SRES scenarios used in CMIP3, which vary from 4.2 to 8.1 W m^{-2} at 2100 (see Figure 5-16).

The SRES scenarios do not assume any policy to control climate change, unlike the RCP scenarios. The RF of RCP2.6 is hence lower by 1.9 W m^{-2} than the three SRES scenarios and very close to the ENSEMBLES E1 scenario (Johns et al., 2011). RCP4.5 and SRES B1 have similar RF at 2100, and comparable time evolution (within 0.2 W m^{-2}). The RF of SRES A2 is lower than RCP8.5 throughout the 21st century, mainly due to a faster decline in the radiative effect of aerosols in RCP8.5 than SRES A2, but they converge to within 0.1 W m^{-2} at 2100. RCP6.0 lies in between SRES B1 and SRES A1B. Results obtained with one General Circulation Model (GCM) (Dufresne et al., 2013) and with a reduced-complexity model (Rogelj et al., 2012) confirm that the differences in temperature responses are consistent with the differences in RFs estimates. RCP2.6, which assumes strong mitigation action, yields a smaller temperature increase than any SRES scenario. The temperature increase with the RCP4.5 and SRES B1 scenarios are close and the temperature increase is larger with RCP8.5 than with SRES A2. The spread of projected global mean temperature for the RCP scenarios is considerably larger (at both the high and low response ends) than for the three SRES scenarios used in CMIP3 (B1, A1B and A2) as a direct consequence of the larger range of RF across the RCP scenarios compared to that across the three SRES scenarios (IPCC, 2013).

[176] Radiative forcing (RF)

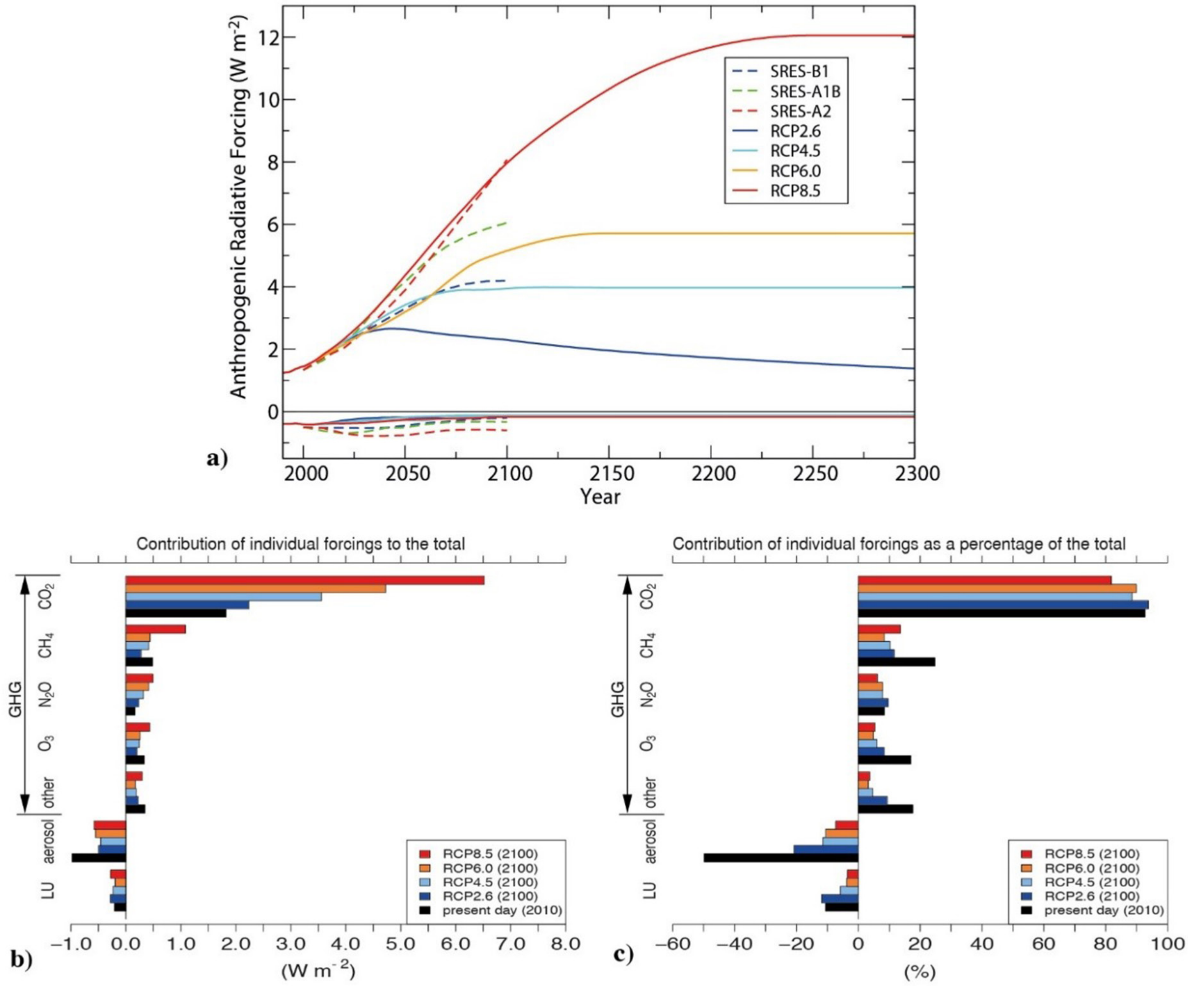


Figure 5-16: (**a**) Time evolution of the total anthropogenic (positive) and anthropogenic aerosol (negative) radiative forcing (RF) relative to pre-industrial (about 1765) between 2000 and 2300 for RCP scenarios and their extensions (continuous lines), and SRES scenarios (dashed lines) as computed by the Integrated Assessment Models (IAMs) used to develop those scenarios. The four RCP scenarios used in CMIP5 are RCP2.6 (dark blue), RCP4.5 (light blue), RCP6.0 (orange) and RCP8.5 (red). The three SRES scenarios used in CMIP3 are B1 (blue, dashed), A1B (green, dashed) and A2 (red, dashed). Positive values correspond to the total anthropogenic RF. Negative values correspond to the forcing from all anthropogenic aerosol–radiation interactions (i.e., direct effects only). The total RF of the SRES and RCP families of scenarios differs in 2000 because the number of forcing represented and our knowledge about them have changed since the TAR. The total RF of the RCP family is computed taking into account the efficacy of the various forcing (Meinshausen et al., 2011a); (**b**) Contribution of the individual anthropogenic forcing to the total RF in year 2100 for the four RCP scenarios and at present day (year 2010). The individual forcing are gathered into seven groups: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), other greenhouse gases, aerosol (all effects unlike in (a), i.e., aerosol–radiation and aerosol–cloud interactions, aerosol deposition on snow) and land use (LU); (**c**) As in (b), but the individual forcing are relative to the total RF (i.e., RF x /RF tot, in %, with RF x individual RFs and RF tot total RF).

Source: IPCC, 2013.

Although not an advance, as time has moved on, the baseline period from which climate change is expressed has also moved on (a common baseline period of 1986–2005 is used throughout, consistent with the 2006 start-point for the RCP scenarios). Hence, climate change is expressed as a change with respect to a recent period of history, rather than a time before significant anthropogenic influence. It should be borne in mind that some anthropogenically forced climate change had already occurred by the 1986–2005 period (IPCC, 2013).

Data and Processing: In order to predict regional climate change for validation and downscaling procedure there were used the observed climate data for 1986-2005 periods, recorded from 15 meteorological stations (Briceni, Balti, Soroca, Falesti, Bravicea, Cornesti, Dubasari, Camenca, Ribnita, Baltata, Chișinău, Tiraspol, Leova, Comrat, Cahul) by State Hydrometeorological Service, which include: daily and monthly total precipitation; mean, minimum, maximum temperatures and relative air humidity, wind and solar radiation.

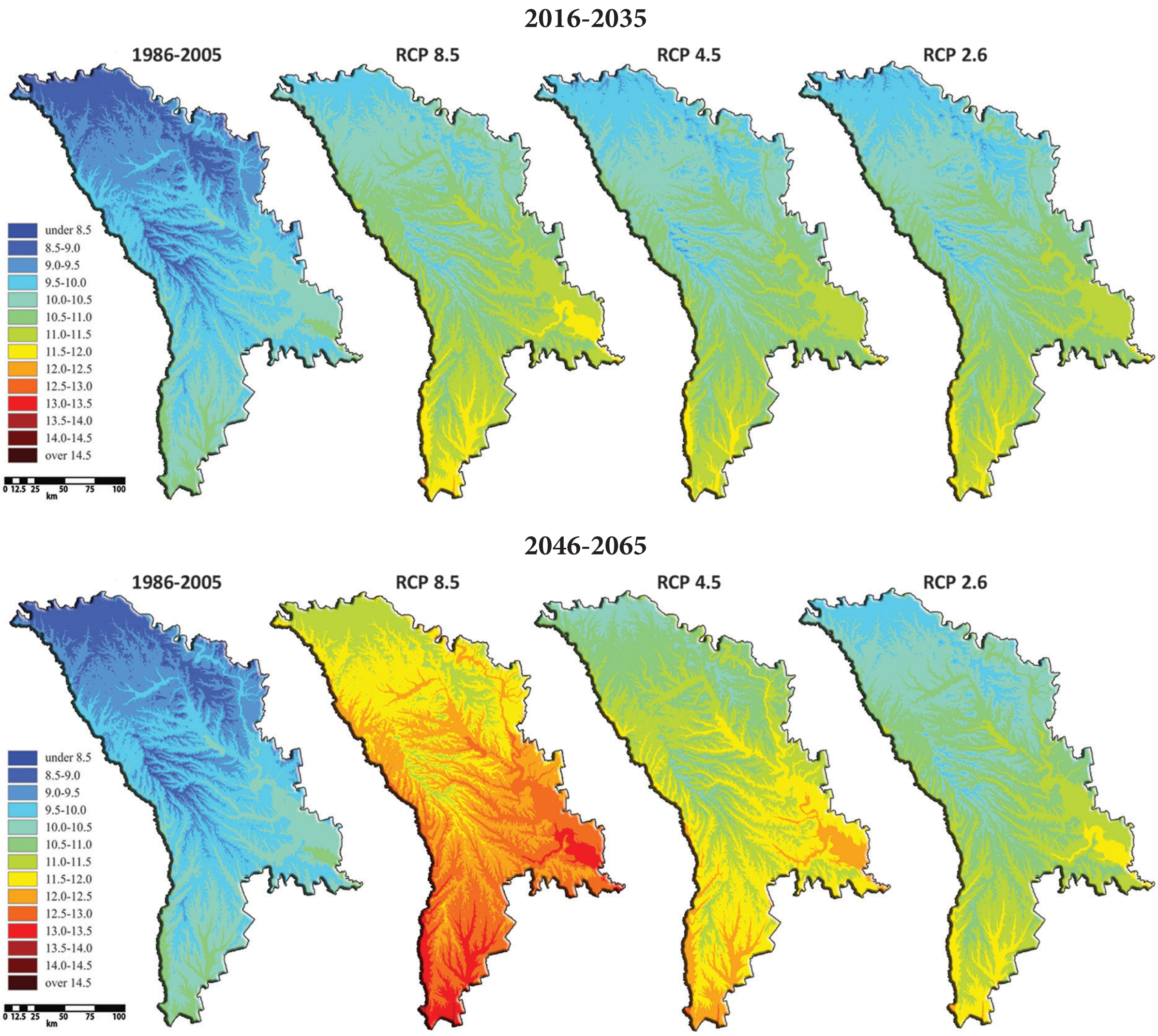
The projections of future climate were obtained conform methodology described by (Wilby et al. 2004; Carter, 2007). Firstly, the baseline climatology was established for the site or region of interest. Secondly, changes in mean, maximum and minimum temperature for the GCM grid–boxes closest to the target site were calculated as the difference between each model's future simulation and the same model's baseline simulation, whereas mean precipitation were based on the ratio of a given model's future precipitation to the same model's baseline precipitation (expressed as a percentage change). For example, a difference of 2.5°C might occur by subtracting the mean GCM temperatures for 1986 -2005 from the mean of the 2016-2065. Thirdly, the temperature change suggested by the GCM (in this case, +2.5°C) is then simply added to each day in the baseline climatology.

Equal Model Weighting: Model evaluation uses a multitude of techniques and there is no consensus in the community about how to use this information to assign likelihood to different model projections. Consequently, the different CMIP5 models used for the projections are all considered to give equally likely projections in the sense of 'one model, one vote'. Models with variations in physical parameterization schemes are treated as distinct models.

Consequently, ensemble monthly, seasons and annual statistics (the 25th, 50th and 75th percentiles, and the lowest and highest response among the 21 models for temperature in degrees Celsius, °C, and precipitation as a per cent change, %, were computed for the 2016–2035, 2046–2065 and 2081–2100 periods of the Representative Concentration Pathways RCP8.5, RCP4.5 and RCP2.6 experiments. In terms of temporal aggregation, the following seasons have been considered: December–February (DJF), March–May (MAM), June–August (JJA) and September–November (SON). The next sections highlight some of the obtained results.

5.2.2. Projections of Future Changes in Annual and Seasonal Temperatures

The three Representative Concentration Pathways, RCPs project similar temperature in the near-term decades +0.9-1.1°C over the RM. Only beginning around the 2050s the three RCPs scenarios produce temperature patterns that are distinguishable from each other. This is due to both the large inertia of the climate system; it takes centuries for the full climate effects of greenhouse gas emissions to be felt and due to the fact that it takes time for the different scenarios to produce large differences in greenhouse gas concentrations. Annual changes for temperatures are very homogeneous over the RM's AEZs. By the 2080s, the rate of warming is higher under RCP8.5 ensemble, average reach +4.6°C; medium under RCP4.5, +2.4°C, and smaller under the RCP2.6 scenario, ensemble average would be +1.3°C (see **Figure 5-17** and **Table 5-10**).



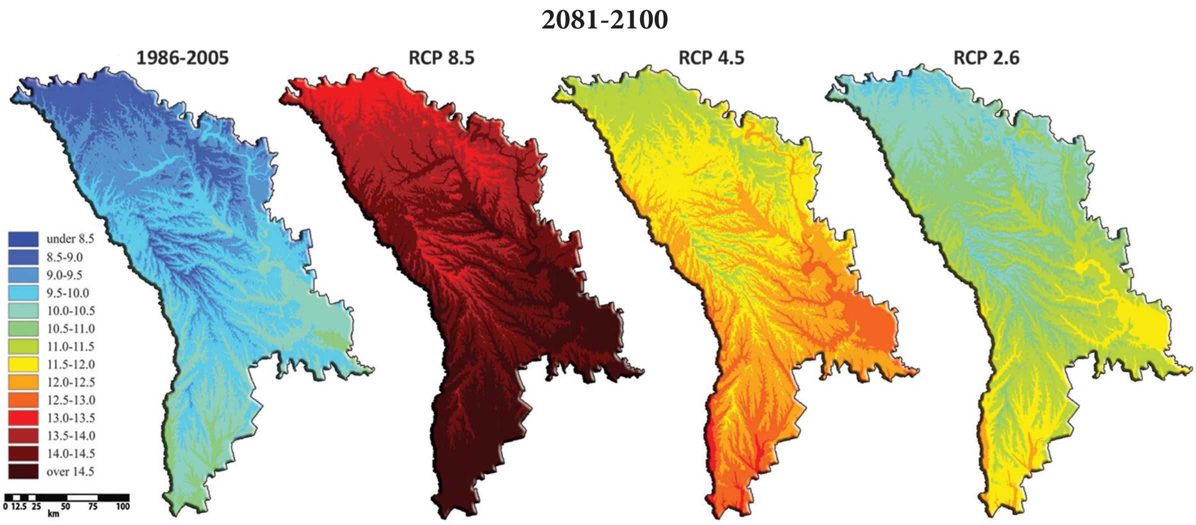


Figure 5-17: Projected CMIP5 21 GCMs Ensemble Annual Mean Air Temperature, °C Development throughout the Republic of Moldova.

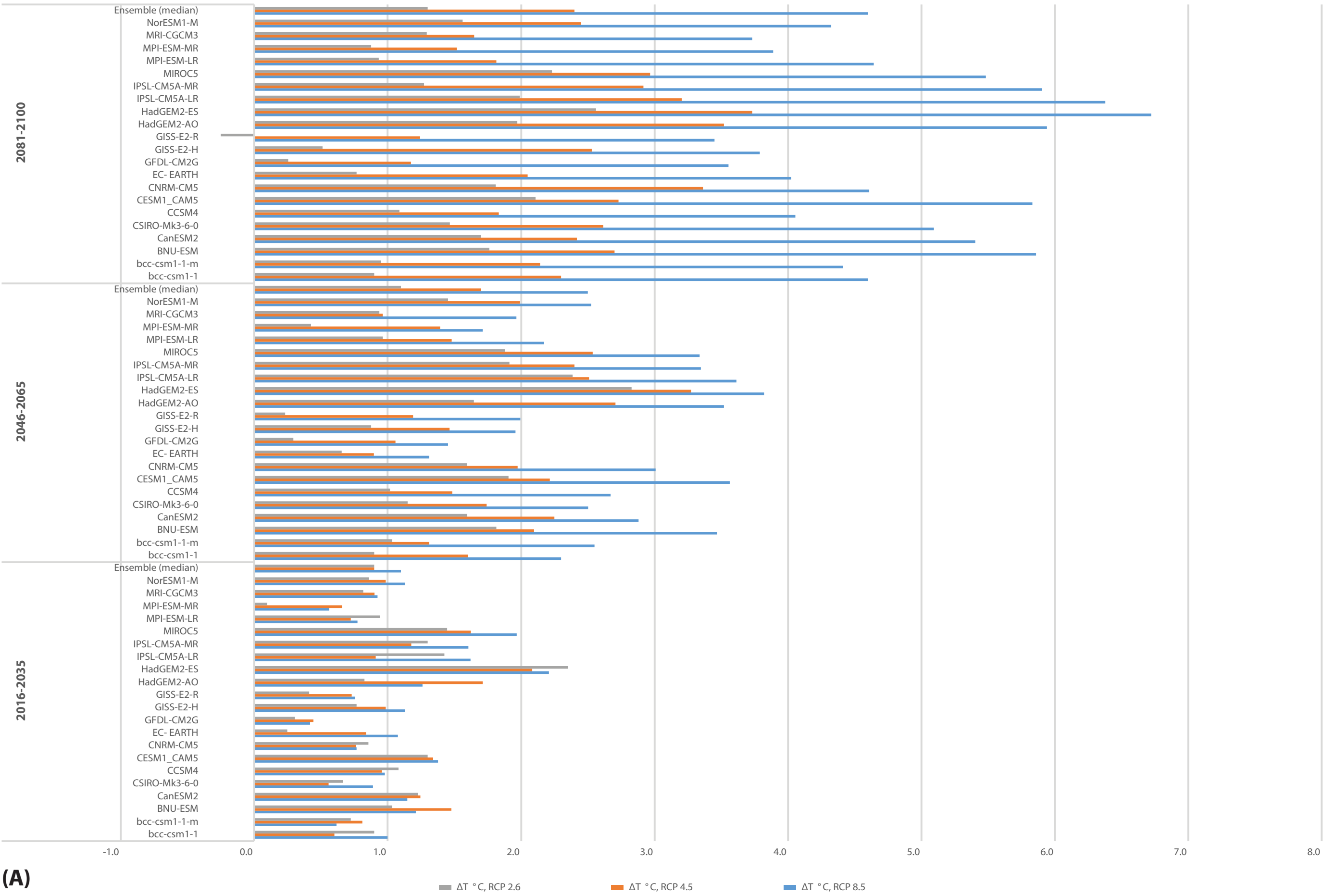
Table 5-10: Projected CMIP5 21 GCMs Ensemble Annual and Seasons Mean Air Temperature Changes (ΔT, °C) Presented for Three 20 Year Time Periods in the Future (2016–2035, 2046–2065, 2081–2100) for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986–2005 Climatological Baseline Period

Season	Average 1986-2005	Scenario	Projected changes by the 2035					Projected changes by the 2065					Projected changes by the 2100				
			Min	25%	50%	75%	Max	Min	25%	50%	75%	Max	Min	25%	50%	75%	Max
Northern AEZ																	
Annual	8.5	RCP8.5	0.4	0.8	1.1	1.3	2.2	1.3	2.0	2.5	3.3	3.8	3.4	4.0	4.6	5.8	6.7
		RCP4.5	0.4	0.7	0.9	1.2	2.1	0.9	1.4	1.7	2.2	3.3	1.2	1.8	2.4	2.9	3.7
		RCP2.6	0.1	0.7	0.9	1.2	2.4	0.2	0.9	1.1	1.8	2.8	-0.3	0.9	1.3	1.8	2.6
DJF	-2.4	RCP8.5	-0.4	0.5	0.8	1.3	2.0	0.7	1.9	2.4	3.1	4.3	3.1	4.0	4.6	5.3	6.9
		RCP4.5	-0.6	0.4	0.8	1.3	1.9	0.4	1.2	1.7	2.2	3.2	0.4	1.7	2.6	3.1	4.1
		RCP2.6	-1.0	0.5	0.8	1.3	2.1	-0.3	0.4	1.2	1.5	2.8	-0.9	0.7	1.4	2.1	2.5
MAM	8.8	RCP8.5	-0.1	0.6	0.9	1.3	2.7	-0.1	0.6	2.0	1.3	2.7	2.5	3.3	3.7	4.7	6.2
		RCP4.5	-0.1	0.5	1.0	1.2	2.3	-0.1	0.6	1.4	1.2	2.3	0.5	1.6	2.1	2.7	3.5
		RCP2.6	0.0	0.3	0.6	1.2	1.9	0.0	0.3	1.2	1.2	1.9	-0.6	0.8	1.4	1.8	2.8
JJA	19.1	RCP8.5	0.3	1.1	1.5	1.8	2.6	1.4	2.2	3.2	3.9	5.3	3.3	5.1	5.9	7.1	8.8
		RCP4.5	0.7	1.0	1.4	1.6	2.4	0.8	1.6	2.2	2.8	4.5	0.7	2.3	2.9	3.2	5.0
		RCP2.6	0.1	0.9	1.3	1.5	2.5	0.3	1.0	1.7	2.2	2.7	0.0	1.0	1.4	1.9	2.9
SON	8.4	RCP8.5	0.3	0.9	1.0	1.5	2.8	0.3	0.9	2.8	1.5	2.8	3.8	4.1	4.7	5.5	7.7
		RCP4.5	0.2	0.8	1.1	1.3	2.5	0.2	0.8	1.8	1.3	2.5	1.2	1.9	2.5	2.8	4.6
		RCP2.6	0.3	0.7	0.9	1.2	3.1	0.3	0.7	1.3	1.2	3.1	-0.2	0.9	1.5	1.8	2.9
Central AEZ																	
Annual	10.1	RCP8.5	0.5	0.8	1.1	1.3	2.1	1.4	2.1	2.6	3.3	3.6	3.6	4.2	4.6	5.6	6.4
		RCP4.5	0.5	0.8	0.9	1.3	2.1	0.9	1.4	1.7	2.3	3.0	1.2	1.9	2.4	2.9	3.4
		RCP2.6	-0.7	0.6	0.9	1.3	2.2	0.2	1.0	1.1	1.7	2.8	-0.3	1.0	1.3	1.8	2.4
DJF	-1.1	RCP8.5	-0.4	0.5	0.8	1.3	1.9	0.8	1.9	2.4	2.9	4.3	3.0	3.9	4.2	5.1	6.7
		RCP4.5	-0.5	0.3	0.6	1.3	2.0	0.4	1.2	1.7	1.9	3.0	0.4	1.8	2.5	3.1	5.0
		RCP2.6	-1.1	0.4	0.7	1.2	2.1	-0.3	0.5	1.2	1.5	2.8	-1.0	0.8	1.2	1.8	2.4
MAM	10.2	RCP8.5	-0.1	0.5	0.8	1.2	2.3	1.2	1.7	1.9	2.8	3.6	2.5	3.5	3.7	4.8	6.2
		RCP4.5	-0.1	0.4	0.9	1.1	2.3	0.5	0.8	1.3	1.8	3.5	0.4	1.5	2.3	2.9	3.7
		RCP2.6	-0.3	0.3	0.4	1.0	1.7	-0.1	0.7	1.1	1.5	2.9	-0.7	0.8	1.3	1.8	2.7
JJA	21.3	RCP8.5	0.4	1.0	1.5	1.6	2.5	1.4	2.4	3.0	3.7	4.7	3.4	5.3	6.0	6.6	8.1
		RCP4.5	0.6	1.0	1.3	1.6	2.0	0.8	1.5	2.2	2.8	4.1	0.7	2.4	2.9	3.2	7.2
		RCP2.6	-1.2	1.0	1.1	1.4	2.5	0.1	1.1	1.7	2.2	2.6	-0.1	1.0	1.3	1.9	2.7
SON	10.1	RCP8.5	0.2	0.9	1.1	1.5	2.5	1.6	2.1	2.7	3.1	4.2	3.8	4.1	4.7	5.4	7.0
		RCP4.5	0.3	0.7	1.2	1.3	2.2	0.8	1.4	1.6	2.4	3.5	1.3	1.9	2.6	2.8	5.4
		RCP2.6	-0.9	0.7	0.8	1.3	2.9	0.3	0.9	1.3	1.7	3.1	-0.2	1.0	1.4	1.7	2.4

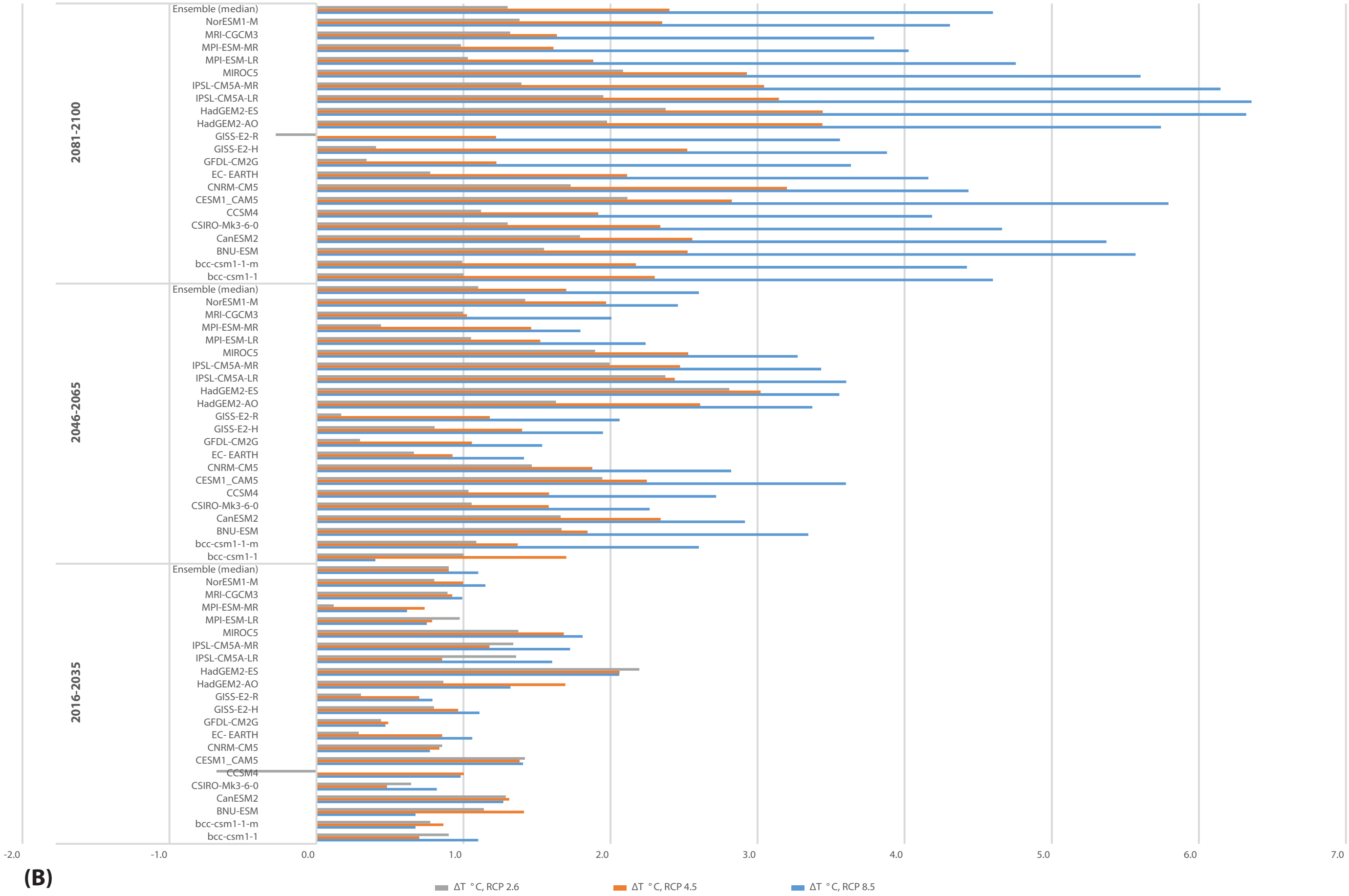
Season	Average 1986-2005	Scenario	Projected changes by the 2035					Projected changes by the 2065					Projected changes by the 2100				
			Min	25%	50%	75%	Max	Min	25%	50%	75%	Max	Min	25%	50%	75%	Max
Southern AEZ																	
Annual	10.2	RCP8.5	0.4	0.8	1.1	1.3	2.0	1.4	2.1	2.6	3.2	3.6	3.4	4.3	4.6	5.4	6.3
		RCP4.5	0.4	0.8	0.9	1.3	2.1	0.9	1.4	1.6	2.3	2.8	1.2	2.0	2.3	2.9	3.4
		RCP2.6	0.1	0.6	0.9	1.3	2.0	0.2	1.0	1.1	1.7	2.7	-0.2	1.0	1.3	1.9	2.3
DJF	-1.1	RCP8.5	-0.2	0.6	0.9	1.3	2.0	1.0	1.9	2.3	3.0	4.2	3.0	3.7	4.3	4.8	6.5
		RCP4.5	-0.2	0.4	0.7	1.3	2.3	0.5	1.2	1.6	2.1	2.8	0.6	1.7	2.5	3.0	5.0
		RCP2.6	-1.0	0.6	0.8	1.2	2.1	-0.1	0.6	1.3	1.4	2.8	-0.8	0.9	1.2	1.9	2.5
MAM	10.1	RCP8.5	-0.1	0.6	0.9	1.3	2.7	-0.1	0.6	2.0	1.3	2.7	2.3	3.4	3.8	4.6	6.3
		RCP4.5	-0.1	0.5	0.9	1.2	2.3	-0.1	0.5	1.3	1.2	1.9	0.3	1.5	2.2	2.9	4.6
		RCP2.6	0.0	0.3	0.8	1.2	1.9	0.0	0.3	0.9	1.2	1.9	-0.6	0.8	1.2	1.8	2.7
JJA	21.3	RCP8.5	0.5	1.2	1.6	1.7	2.4	1.3	2.4	3.2	3.9	4.5	3.6	5.3	6.1	6.7	8.0
		RCP4.5	0.2	1.1	1.3	1.7	2.0	1.0	1.7	2.3	2.8	3.3	1.2	2.6	2.9	3.2	6.7
		RCP2.6	-0.4	1.0	1.2	1.6	2.0	0.2	1.4	1.6	2.2	2.5	0.0	1.2	1.5	1.9	2.6
SON	10.4	RCP8.5	0.3	0.9	1.2	1.5	2.8	0.3	0.9	2.7	1.5	2.8	3.7	4.2	4.7	5.5	6.4
		RCP4.5	0.2	0.8	1.2	1.3	2.5	0.2	0.8	1.7	1.3	2.5	1.4	1.9	2.5	2.8	4.7
		RCP2.6	0.3	0.7	0.9	1.2	3.1	0.3	0.7	1.3	1.2	3.1	-0.3	0.8	1.4	1.9	2.2

Note: Temperature projections by the 21CMIP5 global models. The table shows averages over three AEZs of the projections by a set of 21 global models for the RCP8.5, RCP4.5, and RCP2.6 scenarios. The area-mean temperature responses are first averaged for each model over the 1986–2005 period from the historical simulations and the 2016–2035, 2046–2065 and 2081–2100 periods of the RCP8.5, RCP4.5, and RCP2.6 experiments. Based on the difference between these three periods, the table shows the average and the lowest and highest response among the 21 models, for temperature in degrees Celsius. In terms of temporal aggregation, the following seasons have been considered: December–February (DJF), March–May (MAM), June–August (JJA) and September–November (SON).

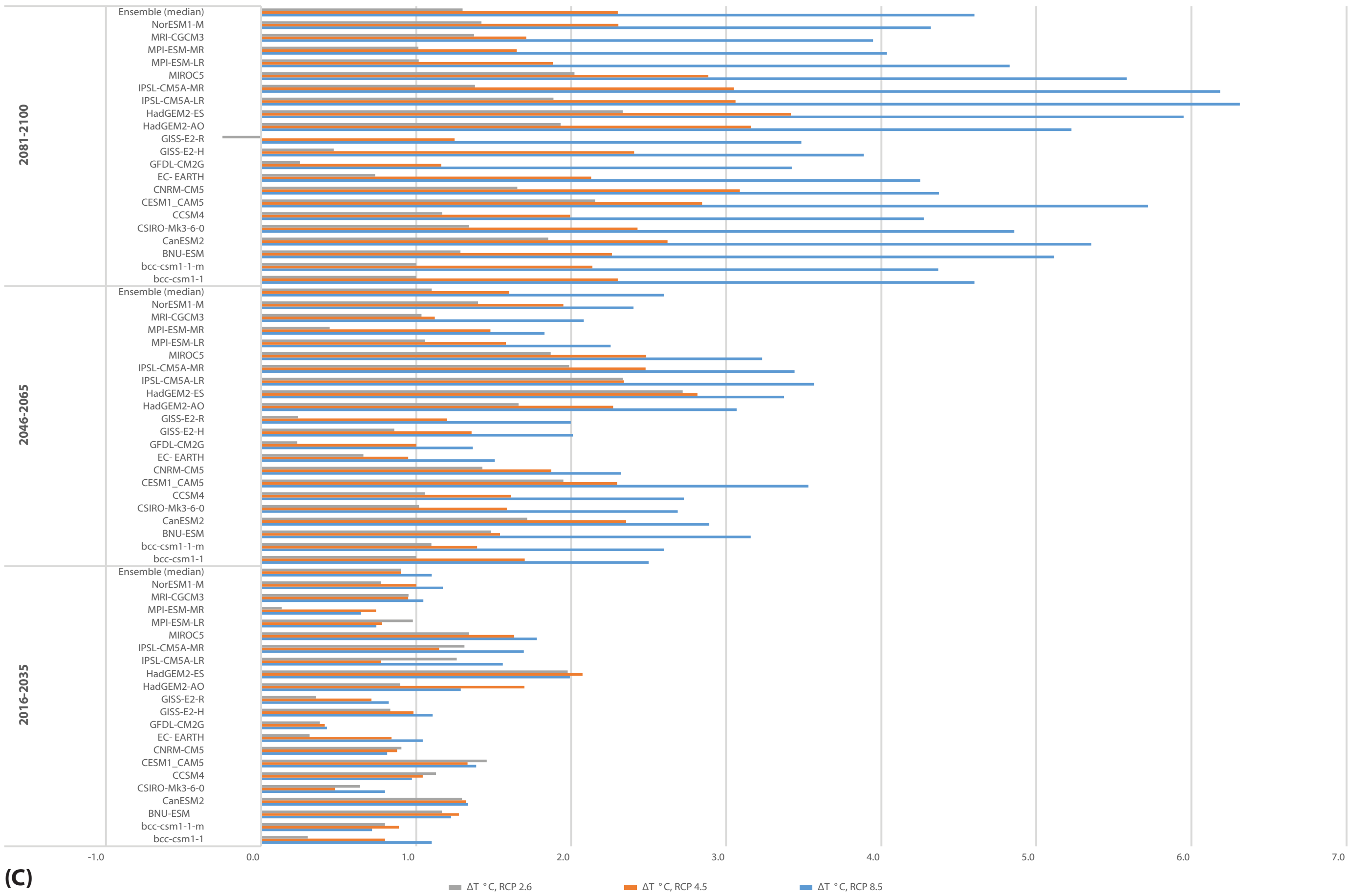
The individual GCMs show an increase of up to 6.3 - 6.7°C (see **Figure 5-18**).



(A)



(B)



(C)

Figure 5-18: Projected Ensemble and Individual 21 GCMs Annual Mean Air Temperature (ΔT, °C) Presented for Three 20 Year Time Periods in the Future (2016–2035, 2046–2065 and 2081–2100) for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6 Relative to the 1986–2005 Climatological Baseline Period in the (A) Briceni, (B) Chisinau and (C) Cahul.

All the GCM models used agree that for the three future periods (2016–2035, 2046–2065 and 2081–2100) there will be an increase of the winter temperature, with respect to the 1986–2005 baseline period. As it was expected, the magnitude of the positive found differences is increasing with increasing greenhouse gas forcing. It can be seen that the temperature rise will be larger over the northern and central parts of the country, **Figure 5-19**.

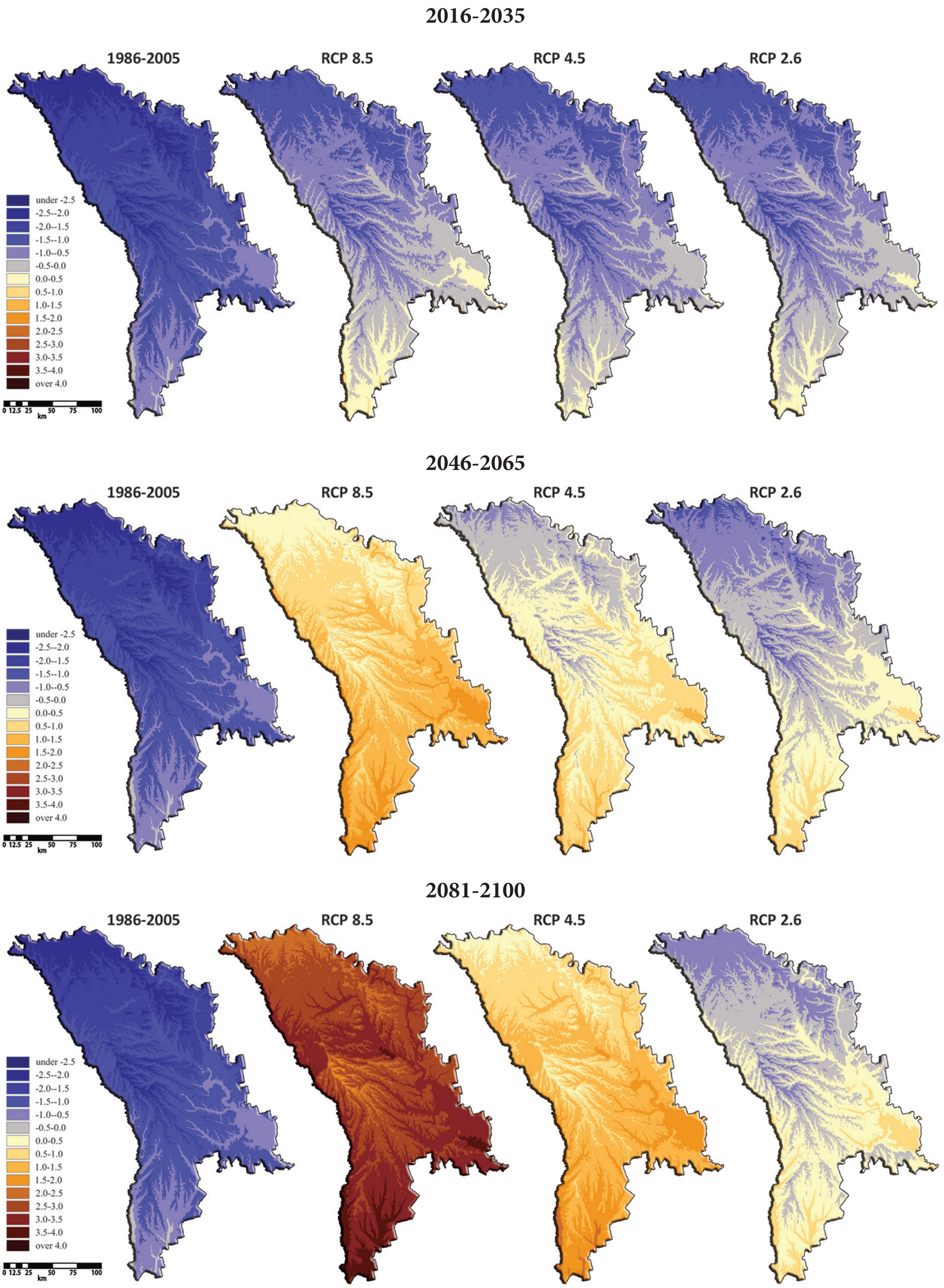


Figure 5-19: Projected CMIP5 21 GCMs Ensemble DJF Mean Air Temperature, °C Development throughout the RM.

The warming would be higher during winter up to +4.6°C over Northern, but in Central and Southern AEZ's temperature rise will be lower up to +4.2°C according to the RCP8.5 scenario. The RCP2.6 scenario reveals less intense warming over the RM's AEZs from +1.2 to +1.4°C. The corresponding results from the RCP4.5 scenario show medium intense differences in temperature increase. Estimates of simulations from the RCP4.5 scenario show that the warming will be quite uniform +2.5-2.6°C over all RM's AEZs, **Table 5-10**.

The summer warming is found to be even higher than in winter, but the spatial distribution of the changes is quite different. The strongest temperature rise occurs over Southern and Central AEZs. The ensemble, driven by RCP8.5 scenario, estimates that the RM AEZs will experience the most significant warming during summer from +5.9 in Northern up to +6.1°C over Southern AEZ's by 2100. The pattern of change derived from the RCP2.6 scenario is quite similar, but the magnitude of change is lower from +1.3 to +1.5°C. The corresponding results from the RCP4.5 scenario show medium intensity differences in temperature increase. Estimates of simulations from the RCP4.5 ensembles show that the warming will be quite uniform, by +2.9°C, over all RM's AEZs, **Table 5-10; Figure 5-20**.

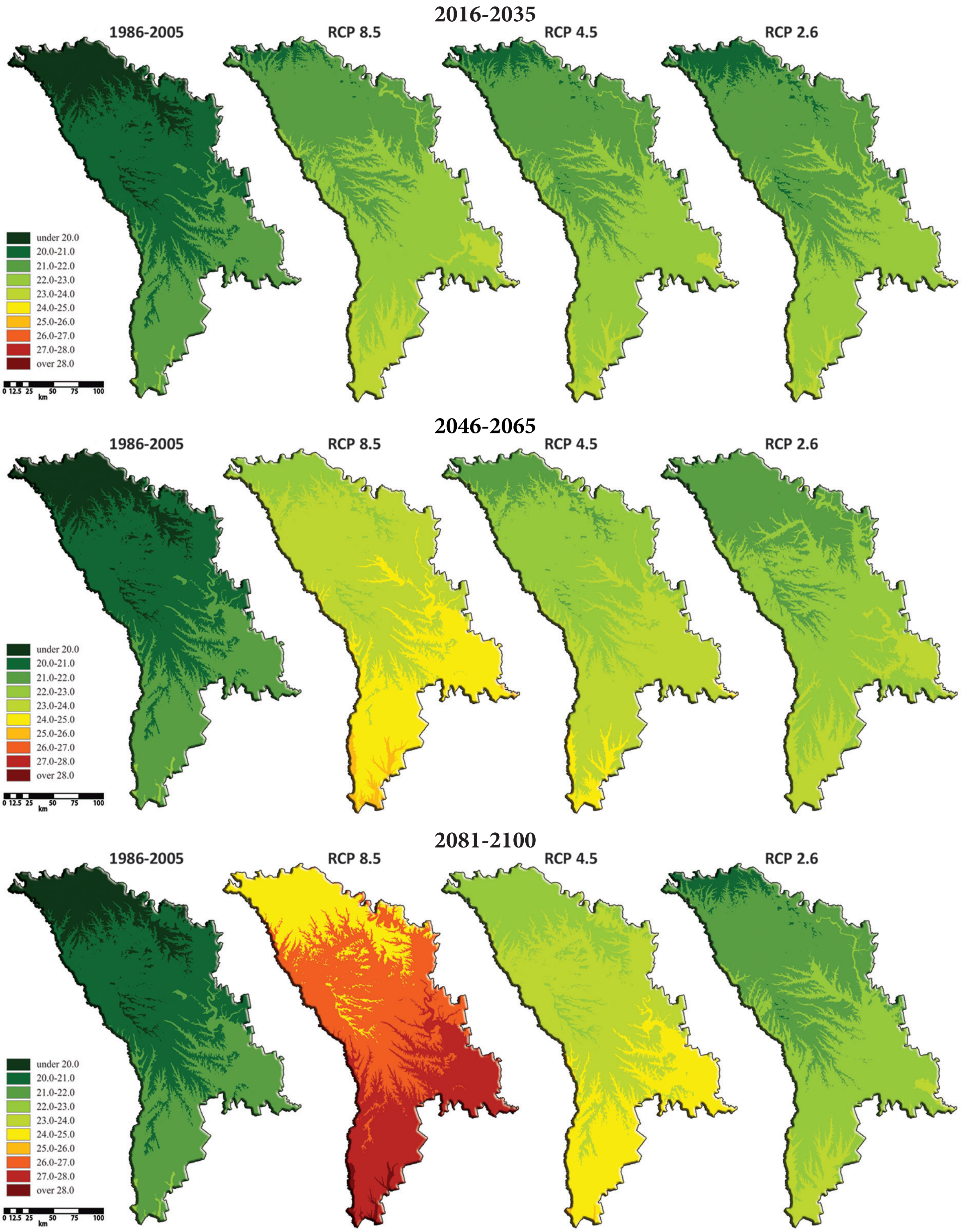


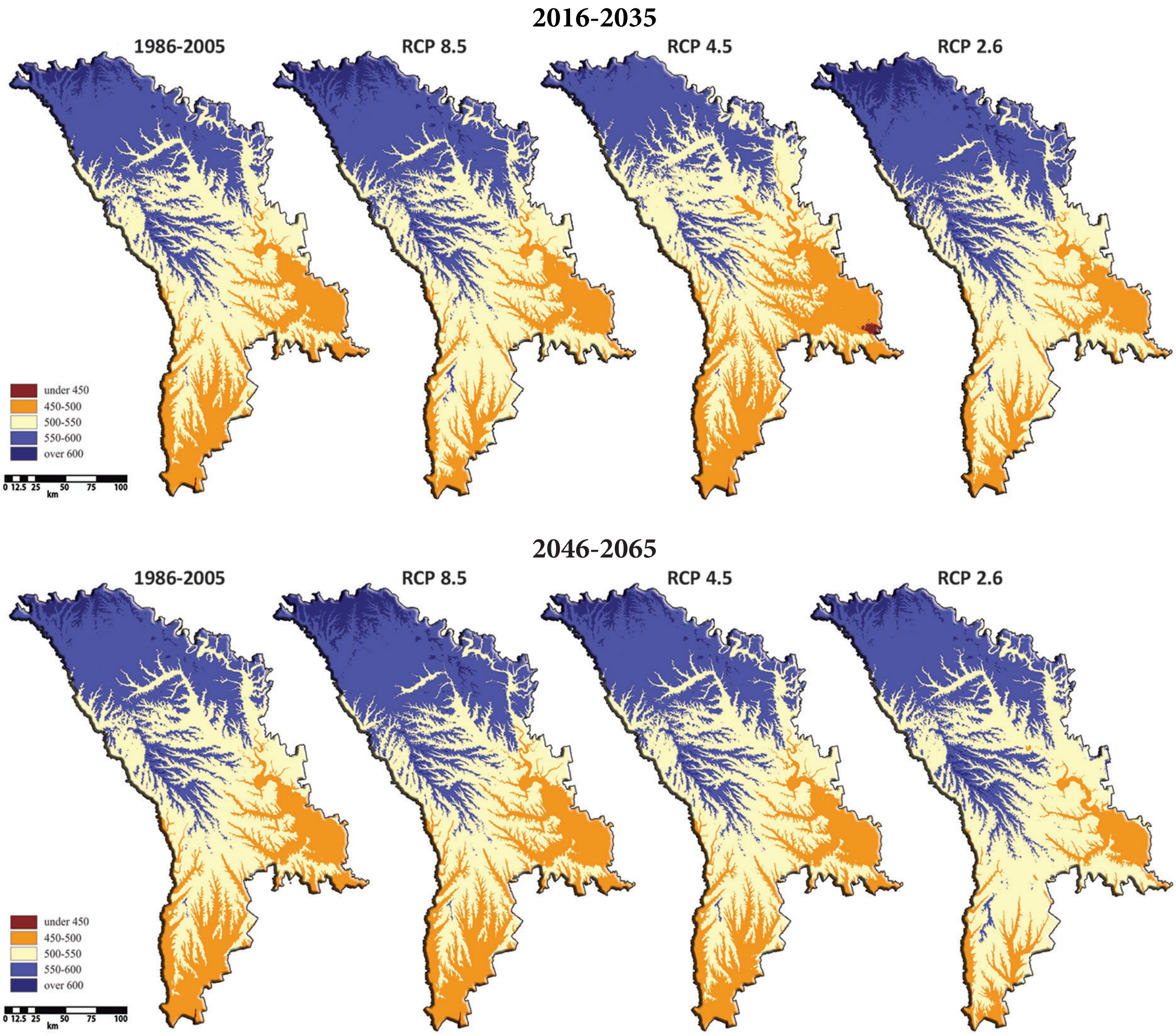
Figure 5-20: Projected CMIP5 21 GCMs Ensemble JJA Mean Air Temperature, °C Development throughout the RM.

5.2.3. Projections of Future Changes in Annual and Seasonal Precipitations

The RCP8.5 and RCP2.6 scenarios project slight precipitation increase around 0.6-2% over all of the RM's AEZs by 2016-2035 period. Conversely, according to RCP4.5 scenario slight decrease in precipitation from -1.5% to 2% is projected for Northern and Central AEZs in comparison to the reference period (1986-2005). Annual changes for precipitation became much more differentiated over the RM's AEZs by the 2100. The multi-model projections from the RCP8.5 forcing scenario show that the RM's AEZs would exhibit a general annual decrease in precipitation varying from 9.9% in Northern to 13.4% to Southern AEZs, **Table 5-11; Figure 5-21**.

Conversely, according to RCP2.6 scenario moderate increase in precipitation from 3.1% in Northern to 5.1% to Southern AEZs by 2100 is projected. The corresponding results from the RCP4.5 scenario show a moderate increase in precipitation from 1.6% to 3.6% only in Central and Northern AEZs by 2100 relative to the reference time period 1986-2005.

The 21 multi-model projections from the RCP8.5, RCP4.5 and RCP2.6 scenarios show that the RM would exhibit a general increase of precipitation during winter and spring. This increase becomes progressively more intense towards the south in winter and the north in spring during the 2016-2035 period. In detail, the multi-model projections from the RCP8.5 scenario show that the RM's AEZs would exhibit a moderate winter increase in precipitation varying from 2.0% (RCP2.6) to 5.9% (RCP2.6) over Northern and from 2.2% (RCP2.6) to 6.3% (RCP8.5) in Sothern AEZs. Conversely, in spring, increase in precipitation is projected to be more intense from 4.9% (RCP8.5) to 7.1% (RCP2.6) across Northern and less intense from 2.8% (RCP8.5) to 4.4% (RCP2.6) across Sothern AEZs relative to the reference time period 1986-2005.



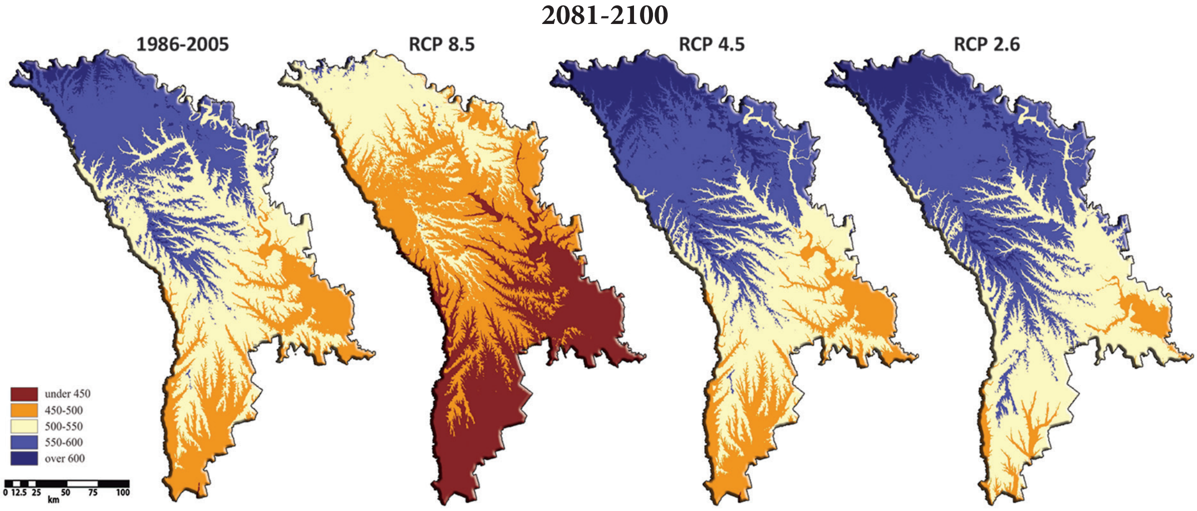
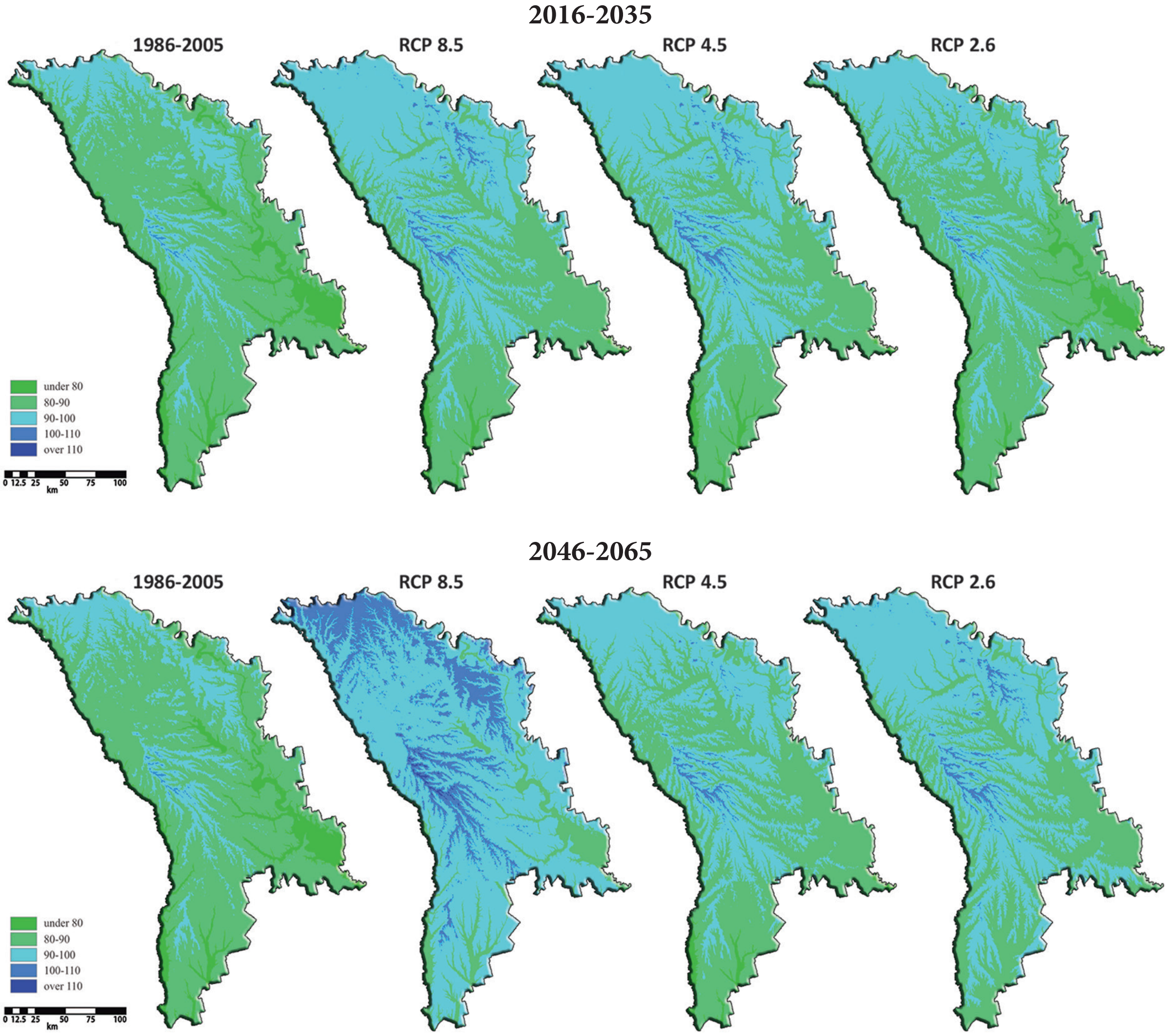


Figure 5-21: Projected CMIP5 21 GCMs Ensemble Annual Precipitation, (mm), Development throughout the RM.

Winters are estimated to be wetter in the RM by the end of the 21st century, **Figure 5-22**. The ensemble projections show the largest increase in precipitation from 4.0% (RCP2.6) to 11.8% (RCP8.5) in winter over Northern and the lowest one from 3.0% (RCP2.6) to 7.4% (RCP8.5) in the Central parts of the country by 2100, **Table 5-11; Figure 5-22**.



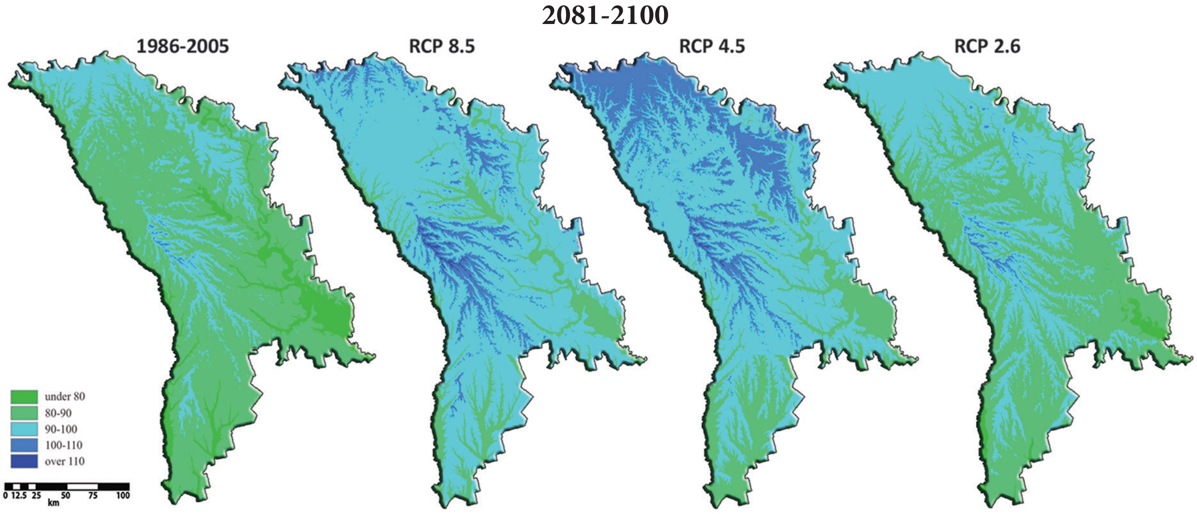


Figure 5-22: Projected CMIP5 21 GCMs Ensemble DJF Precipitation, (mm), Development throughout the RM.

It should be noted that the individual model's climate signal, forced by the RCP8.5, RCP4.5 and RCP2.6 scenarios, presented quite different estimates. For example, the individual models estimate of precipitation change in winter over North AEZ vary from -19.0% (BNU-ESM) to +44.6% (CanESM2) for the RCP8.5 scenario, from -7.8% (BNU-ESM) to +34.2% (CESM1_CAM5) for RCP4.5 and from -11.0% (BNU-ESM) to +25.1% (CanESM2) for the RCP2.6 scenario in comparison to the 1986-2005 reference time period by the 2081-2100. The range of the changes projected over the Southern AEZ is higher varying from -26.2 (IPSL-CM5A-LR) to +24.4% (HadGEM2-AO) for the RCP8.5 scenario, from -16.0 (BNU-ESM) to +27.4% (HadGEM2-AO) for RCP4.5 and from -15.4 (BNU-ESM) to +20.8% IPSL-CM5A-MR) for the RCP2.6 scenario, **Figure 5-23A**.

The ensemble averages for the three RCP scenarios agree that the precipitation reduction will be much more extended in the Republic of Moldova during summer and autumn. The drying conditions are expected to characterize all country regions. The ensemble projections forced by RCP8.5 scenario project the greatest summer rainfall reduction by 25.1% in Central and the lowest one by 18.1% in Northern areas. The pattern for ensemble projection forced by RCP4.5 is quite similar but the magnitude of changes is lower decreasing from 13.2% to 7.4% with maximum seen again over the Central and the minimum one over Northern AEZs relative to the 1986-2005 reference time period by the 2081-2100, **Table 5-11**.

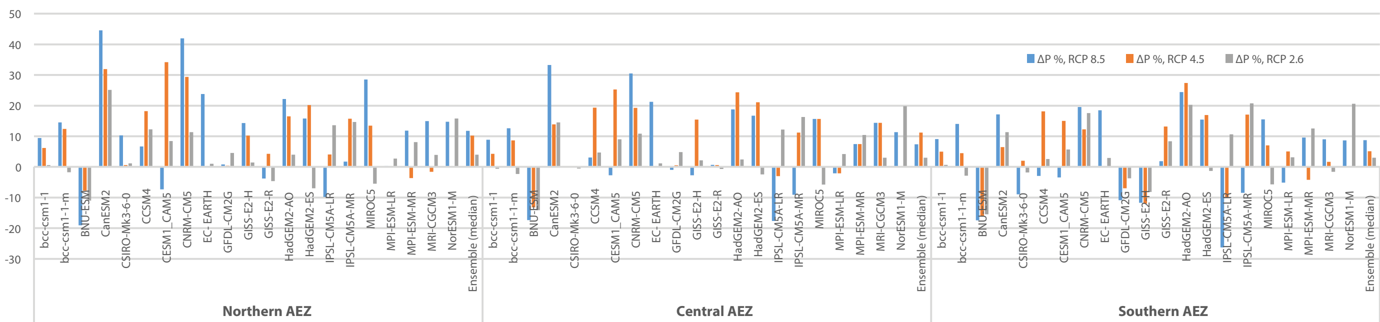
As shown above, large uncertainties as associated with changes in the winter precipitation patterns over the Republic of Moldova climate persist also for summer pattern since model agreement is poor compared to temperature. As example can serve the ensembles individual max and min estimates of precipitation change in summer. According to projections for the North AEZ is the least vulnerable region for summer precipitation, varying from -56.3% (HadGEM2-AO) to +13.8% (MRI-CGCM3) for the RCP8.5 scenario, from -32.9% (bcc-csm1-1-m) to +22.3% (MRI-CGCM3) for RCP 4.5, and from -12.0% (HadGEM2-ES) to +23.3% (NorESM1-M) for the RCP2.6 scenario in comparison to the 1986-2005 reference time period by the 2081-2100. The range of the changes projected for the South AEZ shows that it is the most vulnerable area, varying from -61.7% (HadGEM2-AO) to +8.7% (NorESM1-M) for the RCP8.5 scenario, from -22.8% (CSIRO-Mk3-6-0) to +33.0% (IPSL-CM5A-LR) for RCP4.5 and from -18.1% (BNU-ESM) to +36.5%, **Figure 5-23B**.

Table 5-11: Projected CMIP5 21 GCMs Ensemble Annual and Seasons Mean Precipitation Changes, (%) Presented for Three 20 Year Time Periods in the Future (2016–2035, 2046–2065 and 2081–2100) for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986–2005 Climatological Baseline Period

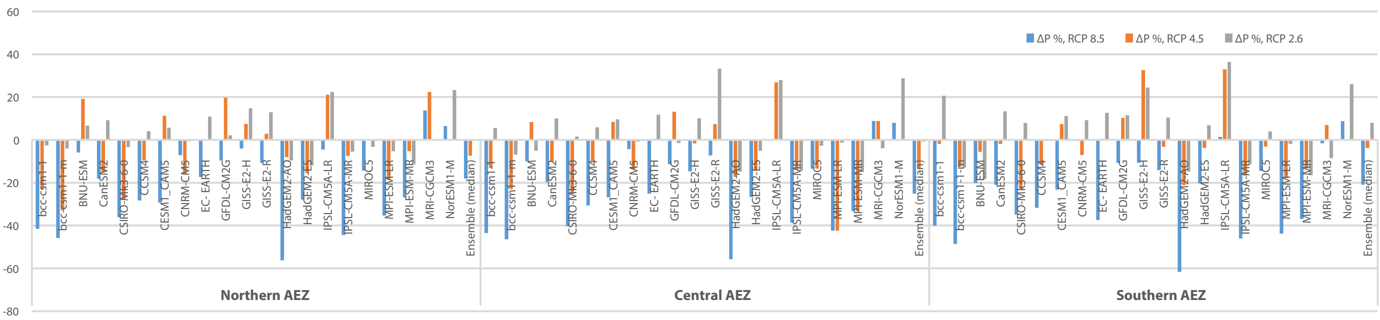
Season	Average 1986-2005	Scenario	Projected changes by the 2035					Projected changes by the 2065					Projected changes by the 2100				
			Min	25%	50%	75%	Max	Min	25%	50%	75%	Max	Min	25%	50%	75%	Max
Northern AEZ																	
Annual	613.8	RCP8.5	-8.2	-3.3	0.6	4.2	16.1	-18.6	-8.3	1.3	4.6	17.1	-20.7	-17.4	-9.9	1.1	31.5
		RCP4.5	-8.9	-3.3	-1.5	4.2	17.4	-9.3	-4.5	-0.3	7.1	13.2	-16.8	-1.0	3.6	8.0	15.3
		RCP2.6	-7.8	-4.7	1.5	4.2	17.7	-5.6	-2.8	1.5	8.4	11.1	-4.8	-0.4	3.1	8.0	19.9
DJF	96.5	RCP8.5	-7.1	-0.5	4.7	11.8	26.4	-11.9	4.6	11.3	18.9	32.6	-19.0	0.8	11.8	15.8	44.6
		RCP4.5	-8.3	0.8	5.9	11.7	29.2	-4.9	0.8	5.0	12.3	38.4	-7.8	0.5	10.2	17.4	34.2
		RCP2.6	-8.3	-3.5	2.0	6.9	22.8	-8.2	1.9	5.9	10.8	20.5	11.0	0.6	4.0	11.3	25.1
MAM	133.5	RCP8.5	-9.6	-1.0	4.9	9.4	29.3	-10.3	-0.5	6.9	15.8	30.5	-13.4	-4.6	-2.5	14.6	56.7
		RCP4.5	-8.5	-2.7	2.1	7.2	25.8	-10.2	-0.8	6.2	14.9	23.8	-5.3	0.8	7.0	17.0	52.5
		RCP2.6	-7.8	-1.4	7.1	9.7	25.4	-5.2	1.0	4.6	11.6	29.3	-4.2	1.7	3.8	7.7	45.3
JJA	245.7	RCP8.5	-16.6	-5.7	0.9	5.6	9.7	-37.5	-17.5	-8.4	3.2	22.6	-56.3	-35.3	-18.1	-7.2	13.8
		RCP4.5	-27.8	-10.0	-6.0	2.6	25.8	-28.0	-11.0	-4.2	9.0	24.6	-32.9	-15.9	-7.4	9.4	22.3
		RCP2.6	-18.1	-10.6	-2.6	4.5	16.0	-19.7	-7.3	-2.0	8.8	13.5	-12.0	-4.0	-0.1	9.3	23.3
SON	138.1	RCP8.5	-21.9	-10.0	-3.4	6.9	38.0	-37.2	-8.9	0.6	4.6	35.2	-43.5	-13.6	-4.8	1.4	69.6
		RCP4.5	-2.9	-8.1	0.3	9.5	45.5	-31.3	-7.0	-0.8	6.2	21.0	-25.6	-7.5	0.2	11.2	22.4
		RCP2.6	-18.1	-4.5	-2.6	4.2	16.0	-17.9	-9.2	-3.6	11.0	22.7	-20.7	-2.1	4.7	14.2	35.7

Season	Average 1986-2005	Scenario	Projected changes by the 2035					Projected changes by the 2065					Projected changes by the 2100				
			Min	25%	50%	75%	Max	Min	25%	50%	75%	Max	Min	25%	50%	75%	Max
Central AEZ																	
Annual	550.4	RCP8.5	-8.5	-2.4	0.1	4.3	14.0	-16.5	-6.1	-0.6	5.3	18.2	-22.1	-16.1	-11.5	-2.8	30.5
		RCP4.5	-9.0	-3.0	-2.0	3.5	19.2	-8.1	-3.6	1.2	4.6	15.2	-13.3	-4.8	1.2	7.4	12.1
		RCP2.6	-8.8	-3.2	0.6	4.2	24.1	-5.8	-2.2	-0.2	9.1	15.1	-8.4	2.2	4.1	9.6	25.0
DJF	97.0	RCP8.5	-10.1	-5.5	5.3	12.7	22.1	-15.7	3.9	10.5	19.5	30.7	-17.6	-2.1	7.4	15.7	33.3
		RCP4.5	-8.4	-1.2	4.7	9.0	26.6	-5.7	-1.9	5.5	3.0	11.1	-13.2	0.6	11.2	17.4	25.3
		RCP2.6	-10.8	-3.5	2.7	8.3	19.9	-11.3	0.3	5.4	8.6	30.3	-14.1	-0.6	3.0	10.4	19.8
MAM	119.9	RCP8.5	-12.8	-1.5	3.7	10.1	24.2	-13.4	-4.2	8.0	16.6	30.7	-29.0	-8.5	-2.6	14.2	62.0
		RCP4.5	-11.9	-2.3	2.3	7.1	30.4	-16.3	1.3	7.1	7.9	13.6	-19.0	-1.4	3.3	17.5	40.5
		RCP2.6	-7.7	-2.0	2.8	11.2	23.4	-8.1	0.1	6.5	14.5	29.6	-3.5	0.0	3.8	8.0	38.2
JJA	188.2	RCP8.5	-18.1	-6.0	1.6	3.6	17.8	-43.2	-17.4	-8.3	0.6	13.6	-55.8	-38.6	-25.1	-10.0	8.8
		RCP4.5	-18.6	-13.7	-5.8	1.7	26.1	-30.0	-10.2	-2.7	-1.1	0.7	-42.4	-15.8	-13.2	7.8	26.9
		RCP2.6	-14.4	-7.5	-2.8	3.1	22.9	-21.7	-7.0	-0.5	8.7	16.9	-15.0	-5.1	-0.7	10.0	33.3
SON	145.3	RCP8.5	-22.1	-10.1	-4.1	8.9	46.5	-38.3	-9.4	-3.4	6.8	32.8	-45.5	-13.0	-10.5	-3.2	49.5
		RCP4.5	-22.6	-9.1	-1.4	5.9	38.9	-25.8	-9.5	-0.1	-1.6	12.5	-27.5	-12.4	-5.9	3.3	23.5
		RCP2.6	-19.8	-4.9	1.4	7.8	44.1	-23.5	-11.5	-0.4	8.8	24.1	-17.8	0.1	5.4	18.3	42.5
Southern AEZ																	
Annual	501.2	RCP8.5	-7.5	-2.2	2.5	5.5	14.0	-15.4	-6.8	0.0	4.8	15.3	-26.4	-18.7	-13.4	-6.7	22.8
		RCP4.5	-12.1	-3.4	-0.3	4.9	16.8	-15.1	-1.7	0.7	5.5	13.1	-12.5	-4.6	0.4	8.2	11.8
		RCP2.6	-7.4	-3.0	2.3	6.8	21.4	-8.9	-2.8	3.5	7.9	16.5	-14.6	3.4	5.1	9.4	23.8
DJF	82.0	RCP8.5	-16.4	-6.6	0.9	12.0	18.8	-17.0	1.9	9.7	18.1	34.8	-26.2	-8.5	8.7	15.5	24.4
		RCP4.5	-9.3	-5.7	6.3	9.6	24.7	-10.7	-3.4	1.1	6.8	41.6	-16.0	-1.3	5.1	14.1	27.4
		RCP2.6	-16.1	-5.9	2.2	7.5	19.2	-13.8	-3.5	4.9	10.8	44.9	-15.4	-1.8	3.0	11.3	20.8
MAM	113.9	RCP8.5	-14.2	-2.8	2.8	13.3	21.5	-13.0	-3.2	7.8	18.5	23.7	-29.9	-11.3	-3.7	14.1	44.3
		RCP4.5	-10.9	-2.9	1.3	9.4	26.6	-14.5	0.5	6.3	14.4	24.8	-16.3	-0.1	8.0	14.1	27.1
		RCP2.6	-6.3	-0.2	4.4	13.0	21.0	-9.4	0.5	7.5	15.2	27.3	-6.5	3.8	6.2	10.6	25.9
JJA	180.6	RCP8.5	-18.3	-6.7	0.6	6.9	22.9	-40.8	-15.4	-7.8	-2.1	15.3	-61.7	-37.4	-20.9	-10.8	8.7
		RCP4.5	-20.8	-11.3	-4.1	1.3	29.8	-26.1	-11.1	-6.0	7.4	36.7	-22.8	-12.9	-3.8	2.6	33.0
		RCP2.6	-14.0	-6.1	-1.9	7.0	30.8	-22.0	-1.8	2.5	11.5	18.0	-18.1	-8.6	8.0	12.7	36.5
SON	124.8	RCP8.5	-25.8	-10.3	-2.8	5.8	44.7	-42.3	-9.0	-3.4	4.3	31.7	-46.4	-19.7	-15.0	-4.5	38.9
		RCP4.5	-31.5	-8.9	-1.3	8.4	35.6	-33.5	-8.9	2.6	8.6	28.4	-27.1	-9.9	0.4	6.6	35.6
		RCP2.6	-25.0	-6.4	1.7	10.4	50.7	-34.3	-13.2	-1.7	11.1	24.6	-20.1	-2.0	6.5	20.6	43.5

Note: The table shows averages over three AEZs of the projections by a set of 21 global models for the RCP8.5, RCP4.5, and RCP2.6 scenarios. The area-mean precipitation responses are first averaged for each model over the 1986–2005 period from the historical simulations and the 2016–2035, 2046–2065 and 2081–2100 periods of the RCP8.5, RCP4.5, and RCP2.6 experiments. Based on the difference between these two periods, the table shows the average and the lowest and highest response among the 21 models, for precipitation in %. In terms of temporal aggregation, the following seasons have been considered: December–February (DJF), March–May (MAM), June–August (JJA) and September–November (SON).



(A) DJF



(B) JJA

Figure 5-23: Projected Total Season Precipitation Changes (ΔP, %), According to the Ensemble and 21 Individual GCMs by the 2081–2100 for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986–2005 Climatological Baseline Period: (A) DJF, (B) JJA.

5.2.4. Projections of Future Changes in Temperature and Precipitation Extreme Events

The most important contribution toward consistent future projections of changes in extremes are the efforts of the Coupled Model Intercomparison Project Phase 3 (CMIP3) (Meehl et al., 2007b) and Phase 5 CMIP5 (Taylor et al., 2012), which provide coordinated simulations from state of-the-art global climate models. Multi-model ensemble simulations have been shown to outperform individual models and are also expected to provide more robust estimates of future changes and model related uncertainties (e.g., Gleckler et al., 2008; Sillmann et al., 2013). CMIP5 features (Taylor et al., 2012) and utilizes a new set of emission scenarios referred to as Representative Concentration Pathways (RCPs) (Moss et al., 2010; van Vuuren et al., 2011b).

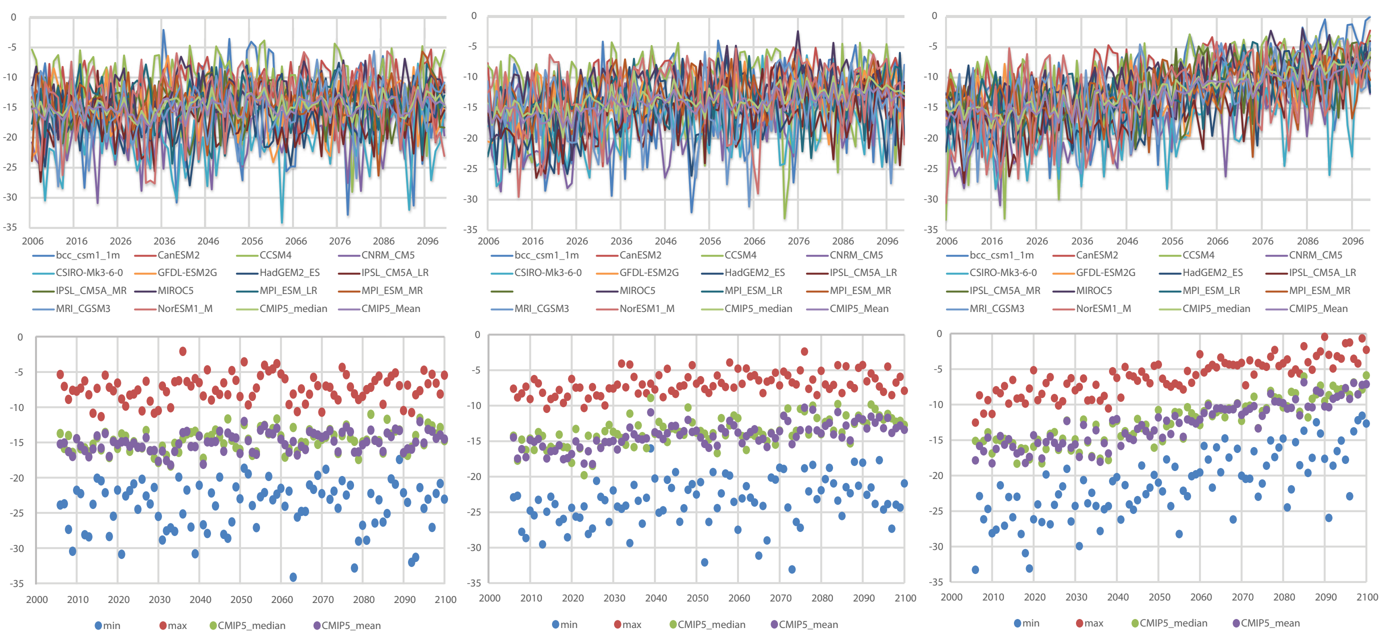
In contrast to the SRES scenarios, the radiative forcing trajectories in the RCPs are not associated with predefined storylines and can reflect various possible combinations of economic, technological, demographic, and policy developments (Moss et al., 2010). The peak and-decline RCP2.6 scenario is designed to meet the 2°C global average warming target compared to pre-industrial conditions (van Vuuren et al., 2011a). It has a peak in the radiative forcing at approximately 3 W/m^2 (~400 ppm CO_2) before 2100 and then declines to 2.6 W/m^2 by the end of the 21st century (~330 ppm CO_2). Radiative forcing in RCP4.5 peaks at about 4.5 W/m^2 (~540 ppm CO_2) in year 2100 (Thomson et al., 2011). RCP4.5 is comparable to the SRES scenario B1 with similar CO_2 concentrations and median temperature increases by 2100 according to Rogelj et al. 2012. RCP8.5 assumes a high rate of radiative forcing increase, peaking at 8.5 W/m^2 (~940 ppm CO_2) in year 2100 (Riahi et al., 2011).

Beside the different emission scenarios and models, differences in the index calculations themselves can also lead to inconsistencies in the analysis and comparison of changes in extremes simulated in the CMIP3 and CMIP5 ensembles. For instance, Tebaldi et al. [2006] used indices that were provided as part of CMIP3 by individual model groups using their own implementations of index calculations, which can lead to inconsistencies. Orlowsky and Seneviratne, 2012 used a larger suite of CMIP3 simulations to calculate a set of indices, which deviated slightly from the ETCCDI definitions (Sillmann et al., 2013).

This study will provide a first look at the performance of the CMIP5 14 multi-model ensemble in simulating climate extreme aspects represented by the indices across the RM AEZs as compared to observed data. The indices are calculated with a consistent methodology across the various data sets discussed in this study and the indices from models are available at the ETCCDI indices archive (EIA) website hosted by the Canadian Centre for Climate Modelling and Analysis (<http://www.cccma.ec.gc.ca/data/climdex/climdex.shtml>) [Sillmann et al., 2013].

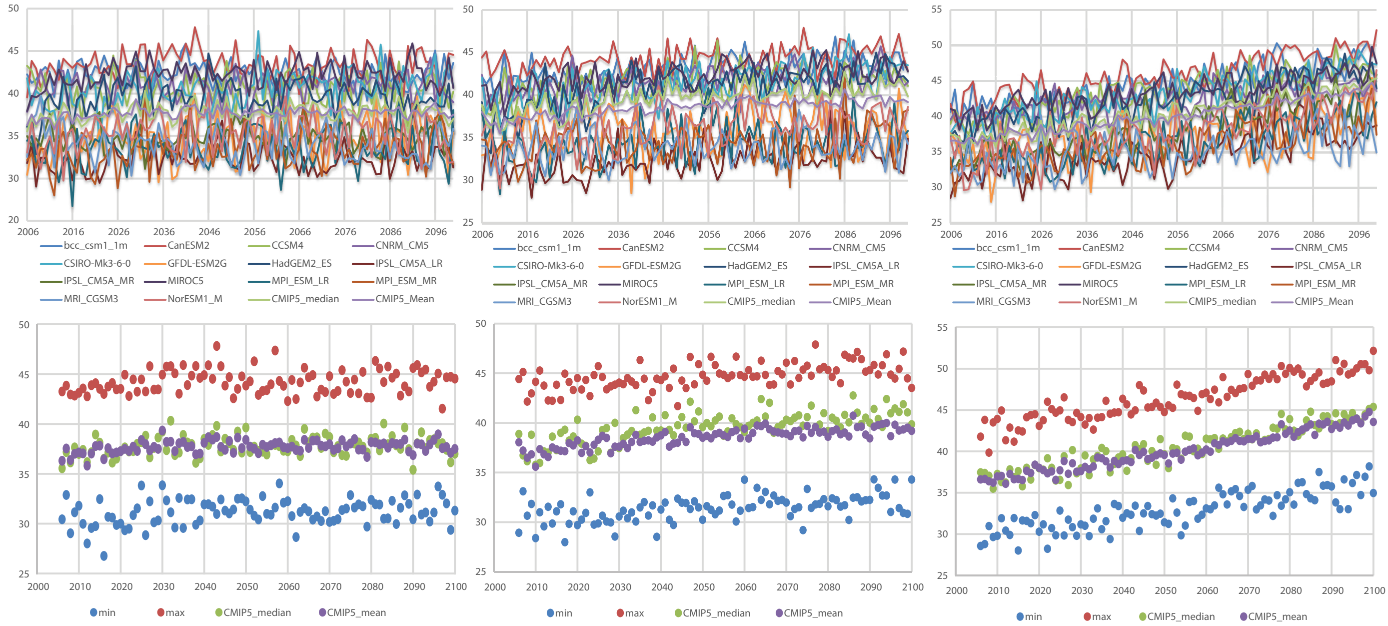
5.2.4.1. Changes in Absolute and Threshold Indices

The **Figures 5-24** and **5-25** illustrate the temporal evolution over 2006-2100 years of annual minimum daily minimum temperature (TNn) and annual maximum daily maximum temperature (TXx) throughout the Republic of Moldova for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, the ensemble median and mean, maximum and minimum of models spread over 2006-2100 years. Warming is observed in both TNn and TXx, with larger increases under RCP8.5, medium RCP4.5, and lower under RCP2.6, with a slightly larger increase in TNn than in TXx under each scenario.



A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-24: Projected CMIP5 14 GSMs Ensemble Annual Minimum Daily Temperature Minimum (TNn), °C Development throughout the Republic of Moldova.



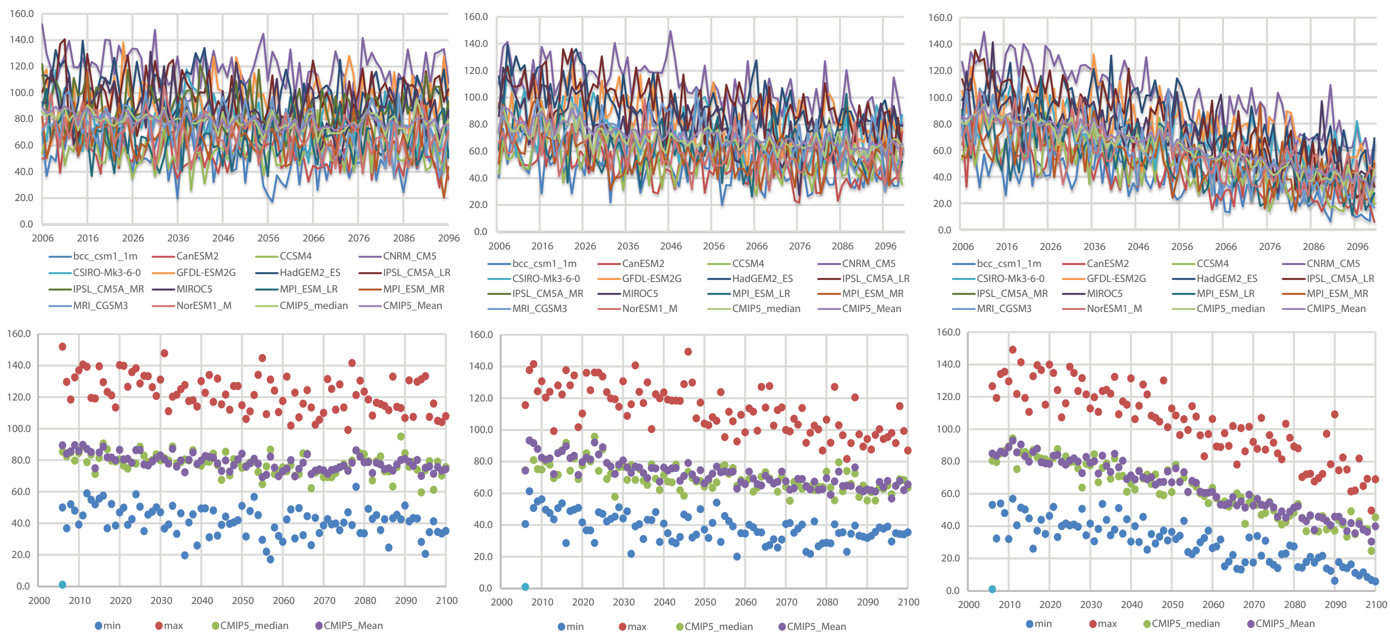
A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-25: Projected CMIP5 14 GSMs Ensemble Annual Maximum Daily Maximum temperature (TXx), °C Development throughout the Republic of Moldova.

The **Table 5-12** displays spatial distribution of the projected changes for annual TNn and TXx by the end of the twenty-first century. The annual TNn and TXx are projected to increase in all three AEZs, with stronger warming under RCP8.5 scenario. The projections under RCP8.5 are also associated with larger interquartile model spread, due to different climate sensitivity of the models. There are some spatial differences in the projected changes in annual TNn and TXx. For instance, under RCP8.5 scenario the largest changes in TNn by +12.8°C occur in Northern AEZ, while the most intense warming in TXx is projected in Southern AEZ, with magnitude around +9.1°C.

Relative to the reference period 1986-2005, the projected ensemble median increases by the end of the twenty-first century will be in TNn from +3.7 in Northern to +2.8°C in Southern AEZs and TXx from +1.9 in Northern to +1.4 °C in Southern AEZs under RCP2.6 scenario, and/or from +9.5 to +7.6°C and from +6.3 to +6.5°C, respectively under RCP8.5 scenario, **Table 5-12**.

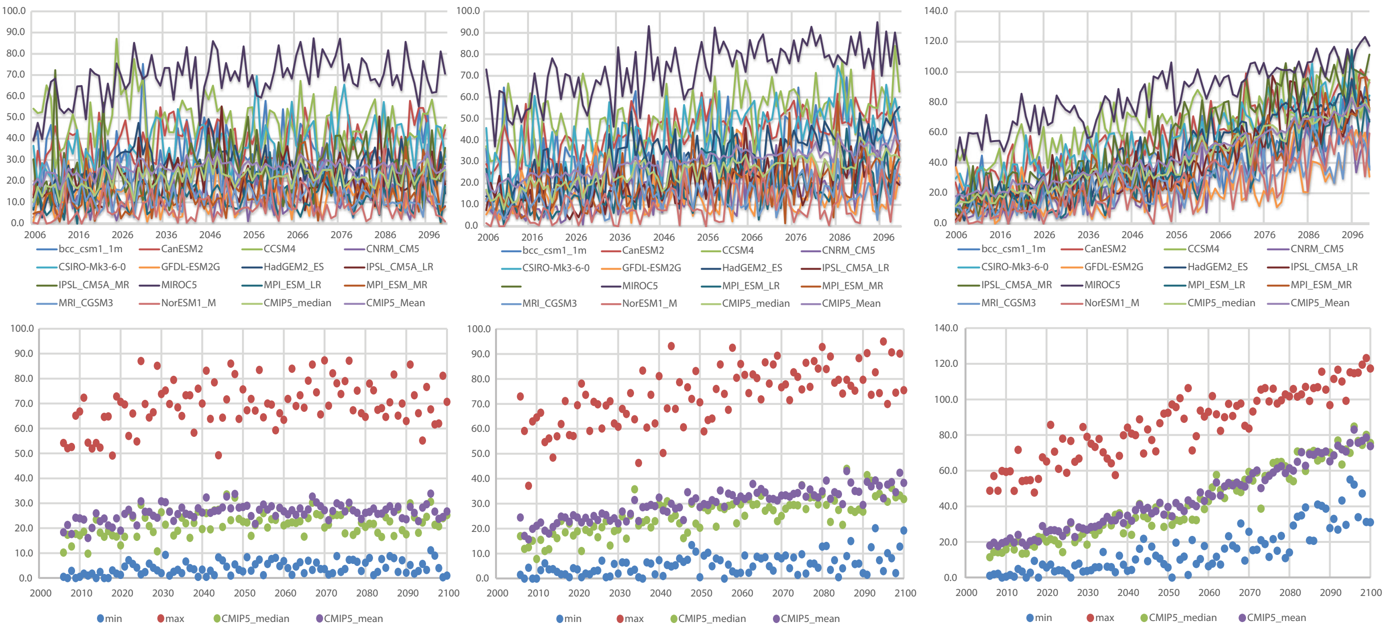
Consistent changes are found in the temperature threshold indices; specially, these indices are frost days (FD) and tropical nights (TN), which are derived from daily minimum temperature (**Figure 5-26** and **5-27**), and ice days (ID) and summer days (SU), which are derived from daily maximum temperature (**Figure 5-28** and **5-29**).



A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-26: Projected CMIP5 14 GSMs Ensemble Frost Days (FD), Development throughout the Republic of Moldova, Days.

Under all three Representative Concentration Pathways, RCPs decrease in FD and IG are projected whereas increases in TR and SU are projected. The FD and ID are both projected to decrease everywhere by the end of the twenty-first century under all three scenarios, with strong model agreement. The projections indicate that the Northern AEZ will experience greatest decrease of FD and ID, with FD decreasing by 83 and ID by 53 days, under RCP8.5. The largest increase in TR and SU is projected under RCP8.5 scenario in Southern AEZ, with an increase of TR and SU by 93 and 83 days, this means that if the future emission follow the path of RCP8.5 scenario of the worst model, Southern AEZ could experience night time temperatures above 20°C and day time temperatures above 25°C during the entire summer season, **Table 5-12**.



A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-27: Projected CMIP5 14 GSMs Ensemble Tropical Nights (TR), Development throughout the Republic of Moldova, Days.

By the end of the twenty-first century under RCP2.6 scenario, the projected ensemble median of FD and ID decrease will be from 14 days in Southern up to 18 in Northern AEZs and from 5 in Southern up to 11 in Northern AEZs, while that of TR and SU increase will be from 6 to 11 days (with maximum in Southern AEZ) for TR and by 16-17 days for SU, respectively.

Projected median changes under RCP8.5 scenario are larger than those under RCP2.6 scenario and 4.5 with a decrease of 36-58 [177] days for FD and 16-27 days for ID, and an increase of 43-60 days for TR (with maximum in Southern AEZ) and 48-56 days for SU, respectively.

[177] Here and throughout the text the first pair of number corresponds to Southern and the second one Northern AEZs

Table 5-12: Projected CMIP5 14 GSMs Ensemble Changes in Temperature Extreme Indices Presented for 2081–2100 years for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986–2005 Climatological Baseline Period

Scenario	*Ensemble*	*DTR*	*CSDI*	*FD*	*ID*	*SU*	*TN10p*	*TN90p*	*TNn*	*TNx*	*TR*	*TX10p*	*TX90p*	*TXn*	*TXx*
								Northern AEZ							
RCP8.5	Average	0.6	-5.5	-55.9	-28.1	55.1	-7.3	37.0	9.2	6.4	47.9	-7.3	36.3	7.4	7.4
	Median	**0.7**	**-5.3**	**-58.4**	**-27.3**	**55.8**	**-7.2**	**35.0**	**9.5**	**6.3**	**43.2**	**-7.2**	**35.8**	**7.5**	**7.7**
	min	-1.2	-10.9	-83.0	-52.7	25.9	-9.8	19.3	5.1	4.1	17.6	-9.3	21.5	4.6	3.2
	max	1.4	-0.7	-38.5	-11.1	75.9	-5.1	51.4	12.8	9.1	83.6	-5.6	53.9	10.0	10.1
	25%	0.4	-6.8	-66.7	-29.8	44.2	-7.5	30.3	7.1	5.5	36.5	-7.9	27.3	6.3	6.5
	75%	1.0	-4.4	-42.8	-22.6	67.1	-7.1	45.8	11.4	7.3	60.5	-6.8	45.5	8.6	8.8
RCP4.5	Average	0.4	-3.9	-28.8	-16.1	27.6	-5.3	16.5	5.2	2.7	14.9	-5.2	17.2	4.5	3.3
	Median	**0.4**	**-4.2**	**-30.6**	**-14.6**	**32.3**	**-4.9**	**14.1**	**5.6**	**2.7**	**14.6**	**-4.9**	**16.9**	**4.6**	**3.4**
	min	-0.6	-8.0	-45.3	-33.3	5.5	-7.0	5.1	0.6	0.2	-0.1	-7.1	6.9	0.5	0.1
	max	1.1	0.1	-14.8	-1.0	43.3	-4.1	27.3	8.2	4.6	37.7	-4.0	27.3	6.3	6.1
	25%	0.1	-5.2	-37.1	-19.9	22.3	-5.9	12.1	3.8	2.1	8.2	-6.0	12.2	3.7	2.9
	75%	0.8	-2.5	-17.9	-11.7	36.6	-4.7	24.1	6.1	3.4	17.3	-4.4	24.1	5.5	3.9
RCP2.6	Average	0.1	-3.1	-18.1	-10.7	15.6	-3.8	10.4	3.3	1.8	8.6	-3.6	9.7	2.7	2.2
	Median	**0.2**	**-2.7**	**-17.8**	**-11.0**	**16.0**	**-3.7**	**10.2**	**3.7**	**1.9**	**6.0**	**-3.6**	**10.1**	**2.5**	**2.1**
	min	-0.5	-8.7	-29.2	-21.7	2.5	-6.2	1.5	0.4	0.6	0.2	-5.8	2.4	0.5	0.2
	max	0.9	0.1	-0.8	-1.8	27.9	-0.5	19.1	5.5	3.2	27.2	-0.9	20.6	4.7	5.4
	25%	0.0	-4.6	-24.2	-13.3	12.2	-4.6	7.4	2.0	1.3	4.1	-4.1	5.7	1.7	1.6
	75%	0.2	-1.4	-13.8	-6.5	19.5	-3.3	13.2	4.6	2.1	12.4	-3.1	11.3	3.7	2.8
1986-2005	Average	**8.6**	**2.0**	**113.8**	**47.5**	**54.1**	**7.1**	**16.0**	**-20.5**	**20.0**	**0.9**	**9.5**	**13.7**	**-11.8**	**33.7**

Scenario	*Ensemble*	*DTR*	*CSDI*	*FD*	*ID*	*SU*	*TN10p*	*TN90p*	*TNn*	*TNx*	*TR*	*TX10p*	*TX90p*	*TXn*	*TXx*
Central AEZ															
RCP8.5	Average	0.1	-5.3	-50.0	-22.4	51.2	-7.2	38.2	8.4	6.3	56.4	-7.1	37.5	7.1	7.5
	Median	**0.6**	**-5.0**	**-48.8**	**-21.1**	**47.0**	**-7.2**	**36.9**	**8.3**	**6.5**	**59.5**	**-7.2**	**36.3**	**7.0**	**7.7**
	min	-5.3	-12.4	-78.1	-47.1	19.9	-10.5	18.3	5.0	4.1	25.2	-9.7	21.9	4.5	4.1
	max	1.3	-1.1	-30.8	-8.5	78.5	-4.4	54.5	11.2	9.1	87.7	-5.2	55.1	10.2	10.1
	25%	0.3	-6.4	-60.4	-25.4	40.5	-7.5	33.5	6.8	5.4	50.3	-7.5	29.0	6.3	6.6
	75%	0.9	-3.7	-38.2	-15.0	63.9	-6.9	45.9	10.3	6.9	62.9	-6.6	47.9	8.2	8.6
RCP4.5	Average	0.0	-3.6	-26.0	-12.9	25.9	-5.1	17.2	4.8	2.6	20.7	-5.2	18.1	4.1	3.4
	Median	**0.4**	**-3.1**	**-25.7**	**-12.2**	**26.3**	**-5.2**	**14.9**	**5.1**	**2.5**	**21.1**	**-5.1**	**17.6**	**4.1**	**3.5**
	min	-5.3	-8.4	-43.4	-29.7	11.5	-6.8	3.6	1.0	0.6	-0.9	-7.0	8.4	-0.1	0.8
	max	1.2	-0.6	-14.5	-0.1	41.4	-3.7	31.9	7.1	4.1	35.9	-3.8	28.1	6.0	6.3
	25%	0.0	-4.6	-30.7	-16.3	18.7	-6.3	12.9	4.3	2.1	14.4	-5.5	12.6	3.5	3.1
	75%	0.7	-2.1	-16.7	-8.9	30.2	-4.4	24.5	5.8	3.0	28.1	-4.5	26.7	5.0	3.7
RCP2.6	Average	-0.2	-3.0	-15.5	-8.5	15.4	-3.6	10.4	2.8	1.7	11.6	-3.7	10.3	2.5	2.2
	Median	**0.1**	**-2.5**	**-14.1**	**-7.6**	**16.2**	**-3.4**	**10.5**	**3.1**	**1.5**	**10.0**	**-3.7**	**9.5**	**2.7**	**2.4**
	min	-5.3	-9.2	-25.7	-19.4	6.3	-5.9	0.7	-0.5	0.9	-0.3	-5.6	3.0	0.2	0.8
	max	0.6	0.3	0.9	-1.3	22.6	-0.8	22.0	4.8	2.9	25.8	-1.3	19.9	4.5	4.0
	25%	0.0	-4.7	-21.4	-10.8	11.5	-4.2	7.5	2.2	1.3	7.3	-4.1	7.0	1.6	1.4
	75%	0.2	-0.6	-12.2	-5.6	18.4	-3.3	12.5	3.9	2.0	15.4	-3.3	12.0	3.3	2.6
1986-2005	**Average**	**8.3**	**4.3**	**96.4**	**36.8**	**75.3**	**8.2**	**16.2**	**-16.9**	**22.4**	**10.7**	**10.1**	**12.5**	**-10.0**	**35.0**
Southern AEZ															
RCP8.5	Average	0.6	-5.0	-45.9	-17.5	52.5	-7.2	40.3	7.7	6.3	62.0	-7.1	39.7	6.6	8.0
	Median	**0.8**	**-4.6**	**-39.4**	**-16.2**	**48.4**	**-7.4**	**39.8**	**7.6**	**6.5**	**60.4**	**-6.9**	**39.2**	**6.3**	**7.7**
	min	-0.7	-12.8	-73.1	-41.4	22.0	-10.8	18.9	4.7	4.4	38.1	-10.1	25.6	4.2	4.6
	max	1.3	-2.4	-29.4	-5.1	82.8	-4.0	55.5	11.4	9.5	93.1	-5.2	56.3	10.2	16.5
	25%	0.2	-5.1	-59.9	-21.9	41.8	-7.5	35.8	6.0	5.5	55.4	-7.3	31.2	5.6	6.4
	75%	1.0	-3.7	-33.4	-9.8	65.5	-6.5	47.6	9.5	7.0	68.4	-6.7	48.9	7.3	8.6
RCP4.5	Average	0.4	-3.5	-24.5	-10.4	26.9	-5.2	19.0	4.5	2.7	24.4	-5.1	19.0	3.9	4.1
	Median	**0.5**	**-3.8**	**-24.7**	**-9.5**	**26.7**	**-5.1**	**18.5**	**5.0**	**2.6**	**24.4**	**-5.1**	**18.5**	**4.3**	**3.5**
	min	-0.1	-8.0	-45.7	-26.1	15.7	-7.1	5.8	0.3	1.5	5.9	-7.2	8.7	0.2	1.7
	max	1.2	0.2	-11.0	-0.1	42.6	-3.6	33.7	6.6	4.3	35.6	-3.8	29.8	5.5	12.4
	25%	0.0	-4.2	-28.0	-13.7	18.7	-6.4	14.3	4.1	2.3	16.6	-5.7	13.4	3.1	2.8
	75%	0.6	-2.6	-14.7	-5.5	33.7	-4.2	25.4	5.7	3.1	32.5	-4.4	27.0	5.0	4.0
RCP2.6	Average	0.2	-2.8	-14.9	-7.2	16.2	-3.8	11.3	2.7	1.6	13.1	-3.7	10.6	2.5	2.7
	Median	**0.1**	**-3.1**	**-13.8**	**-5.3**	**17.3**	**-3.9**	**11.8**	**2.8**	**1.4**	**11.2**	**-3.5**	**9.4**	**2.7**	**2.2**
	min	-0.1	-8.7	-27.6	-17.9	3.6	-5.9	1.6	0.6	1.0	2.7	-5.7	3.2	-0.2	0.8
	max	0.6	2.3	-0.5	-0.7	25.1	-0.7	21.2	4.4	2.7	23.7	-0.9	19.9	4.4	11.9
	25%	0.0	-4.3	-21.2	-8.1	12.1	-4.7	8.2	1.7	1.3	9.2	-4.2	7.7	1.5	1.3
	75%	0.3	-1.3	-10.1	-4.4	19.9	-2.9	13.5	3.7	1.8	18.5	-3.2	12.8	3.4	2.5
1986-2005	Average	**8.7**	**5.8**	**97.5**	**35.1**	**80.7**	**9.9**	**13.6**	**-17.1**	**22.7**	**9.6**	**10.3**	**12.8**	**-9.5**	**35.0**

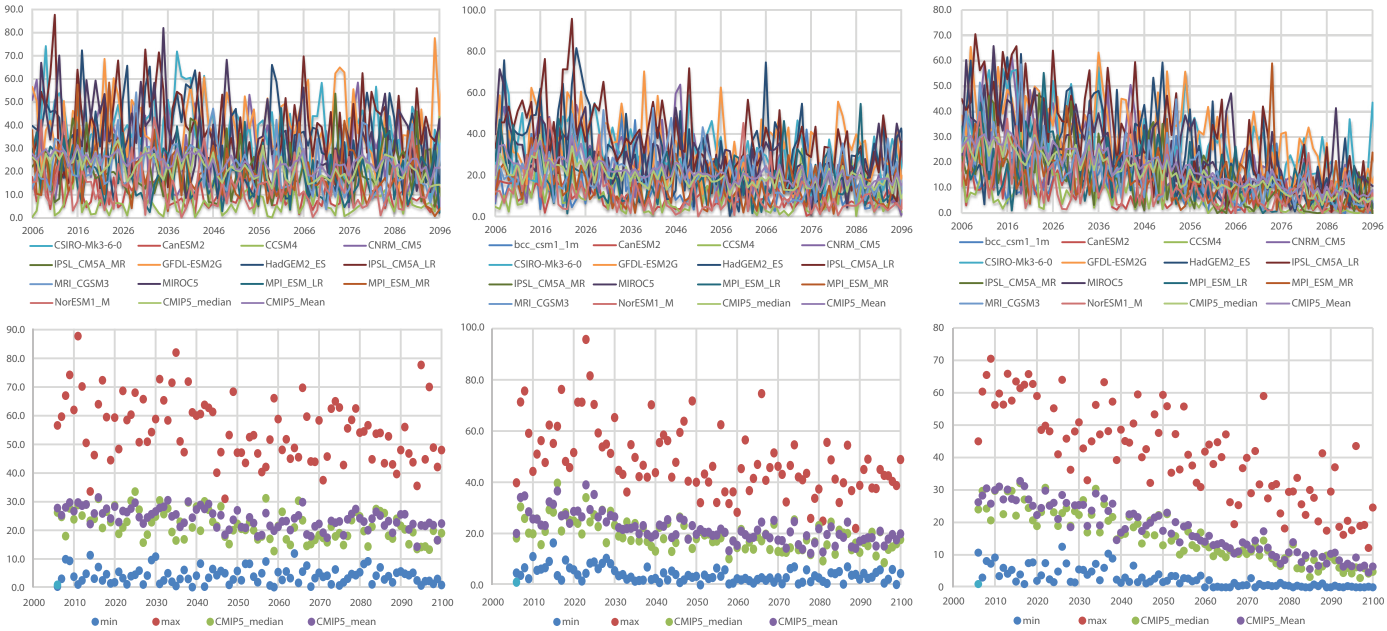


Figure 5-28: Projected CMIP5 14 GSMs Ensemble Ice Days (ID), Development throughout the Republic of Moldova, Days.

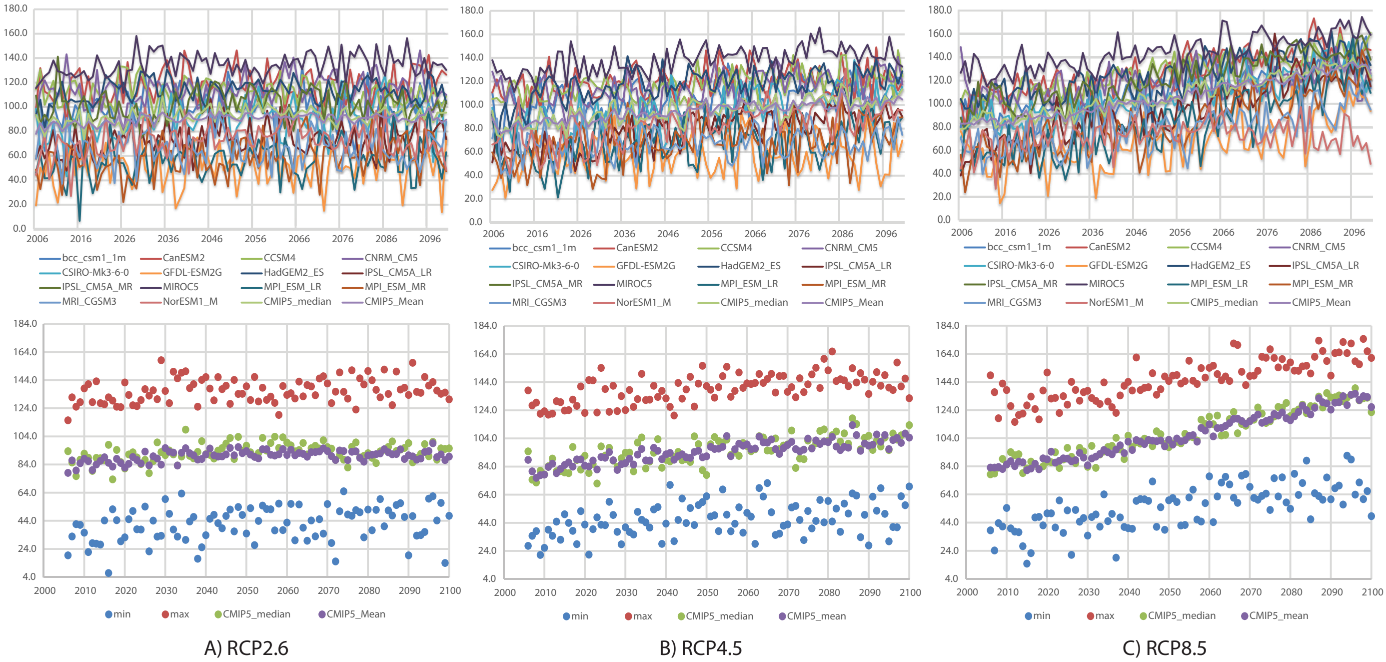


Figure 5-29: Projected CMIP5 14 GSMs Ensemble Summer Days (SU), Development throughout the Republic of Moldova, Days.

5.2.4.2. Changes in Duration and Percentile Indices

The projected changes in temperature duration indices are consistent with what would be expected from warming and changes in absolute and threshold indices. That is, the cold spell duration index (CSDI) is projected to decrease and warm spell duration index (WSDI) to increase, **Figure 5-30 and 5-31**.

The projected trend of decrease in WSDI is much larger under RCP8.5 scenario by 1.5 days/year (129 days) than RCP2.6 scenario by 0.15 days/year (27 days). The projected trend of decrease in CSDI is more comparable under RCP2.6 and RCP8.5 scenarios the median projected decrease being about 3 days (Southern AEZ) and 5 days (Northern AEZ), respectively. The asymmetry in the projected change of CSDI is due to the fact that the projected CSDI under the three scenarios would be mostly zero by the end of the twenty-first century, **Table 5-12**.

Projected change of the cold nights (TN10p) and cold days (TX10p), warm nights (TN90p), and warm days (TX90p) throughout the Republic of Moldova for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, the ensemble median and mean, maximum and minimum of models spread over 2006-2100 years are shown in **Figures 5-32, 5-33, 5-34** and **5-35.** Consistent with warming and projections of the absolute and threshold temperature indices, a decrease in TN10p and TX10p, and an increase in TN90p and TX90p are projected.

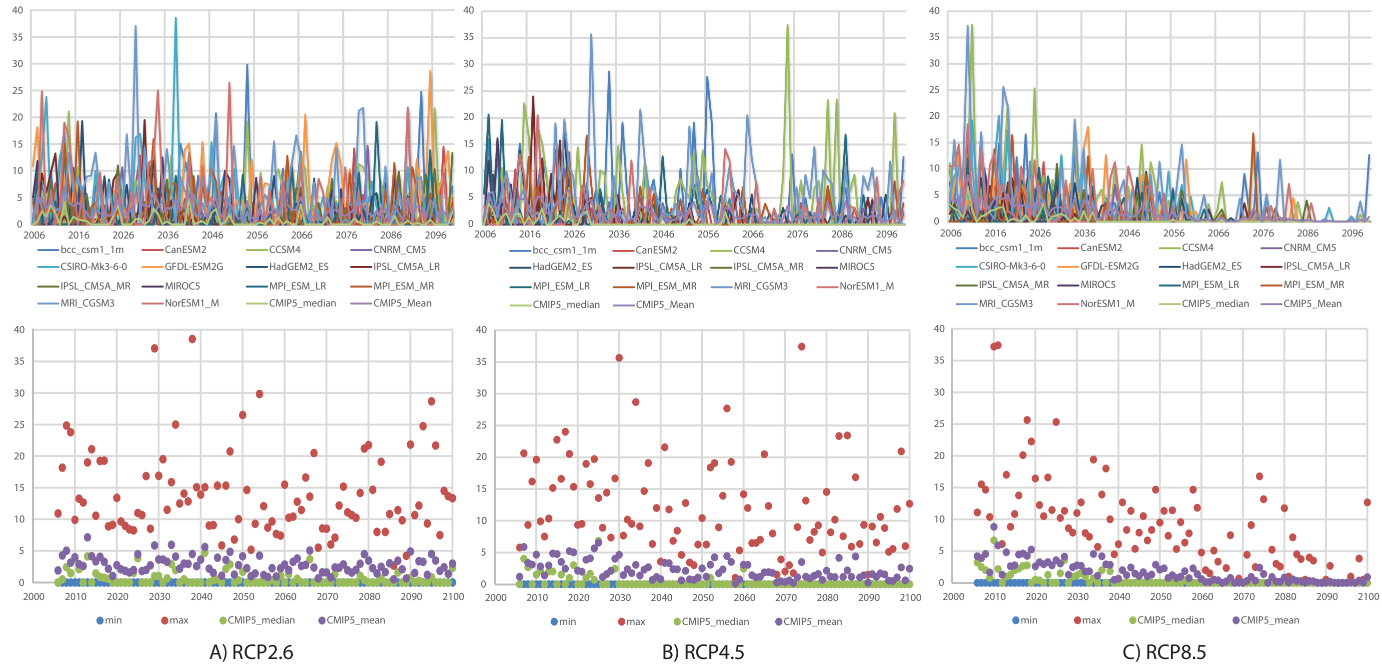
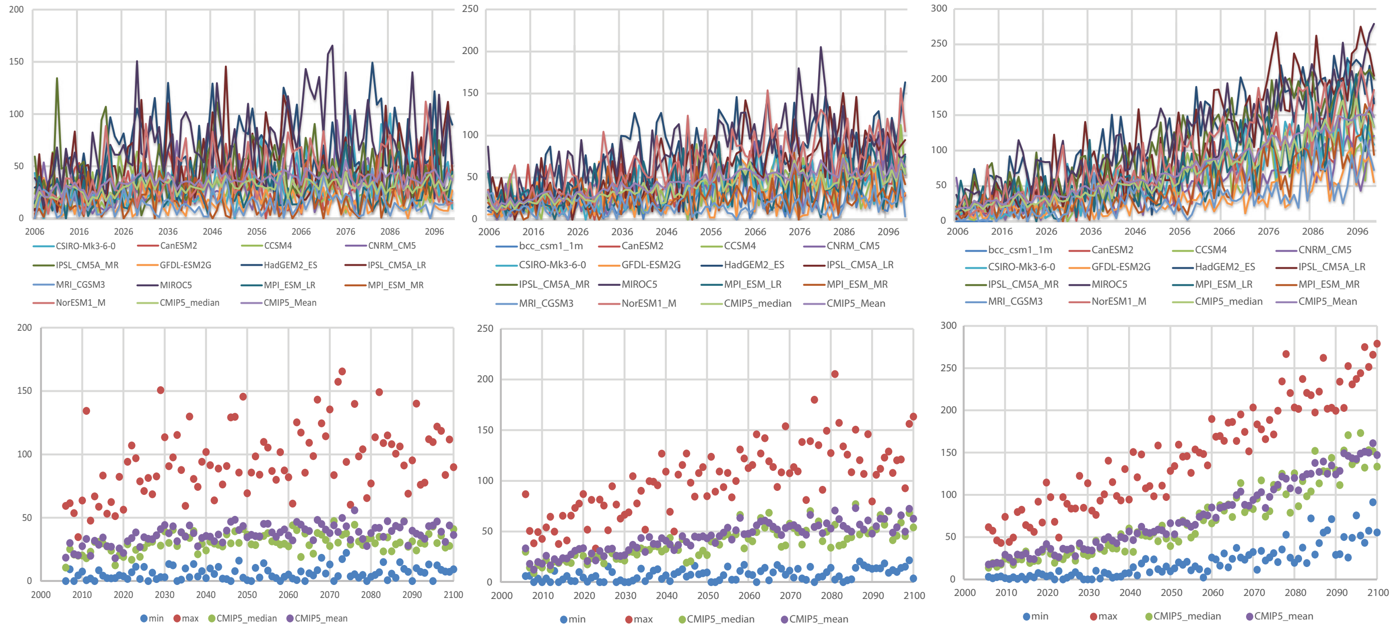
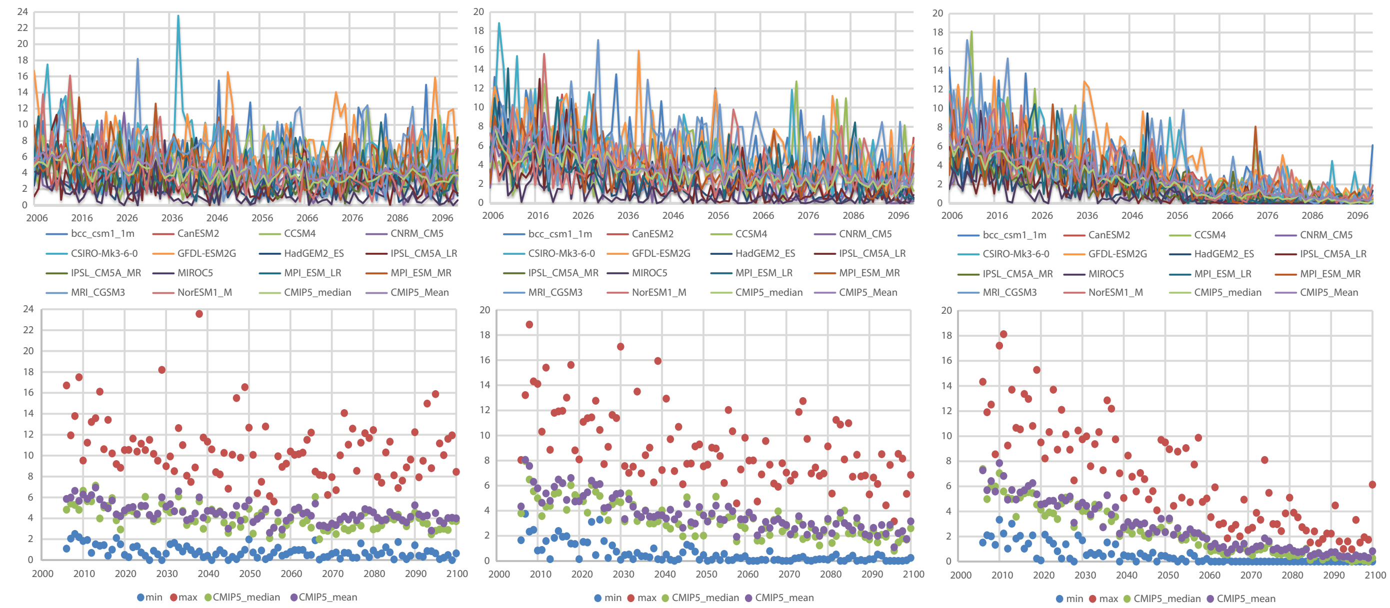


Figure 5-30: Projected CMIP5 14 GSMs Ensemble Cold Spell Duration Index (CSDI), Days, Development throughout the Republic of Moldova.



A) RCP2.6 B) RCP4.5 C) RCP8.5

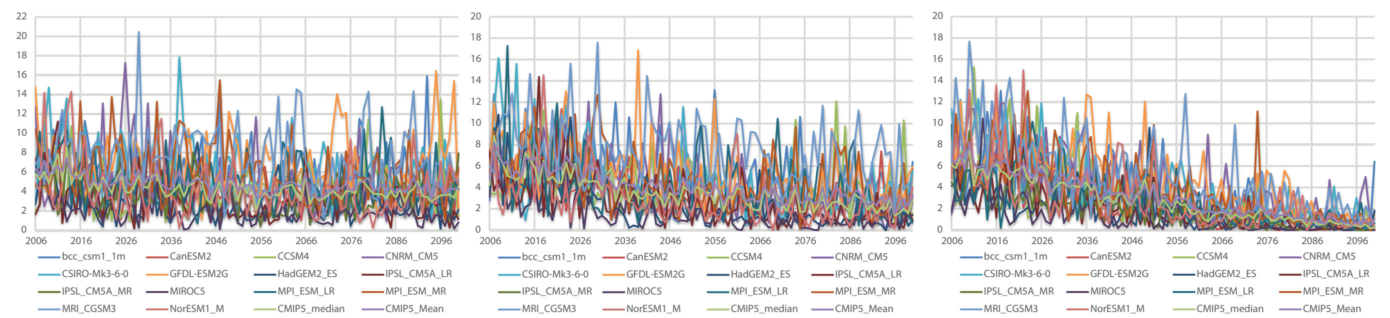
Figure 5-31: Projected CMIP5 14 GSMs Ensemble Warm Spell Duration Index (WSDI), Days, Development throughout the Republic of Moldova.

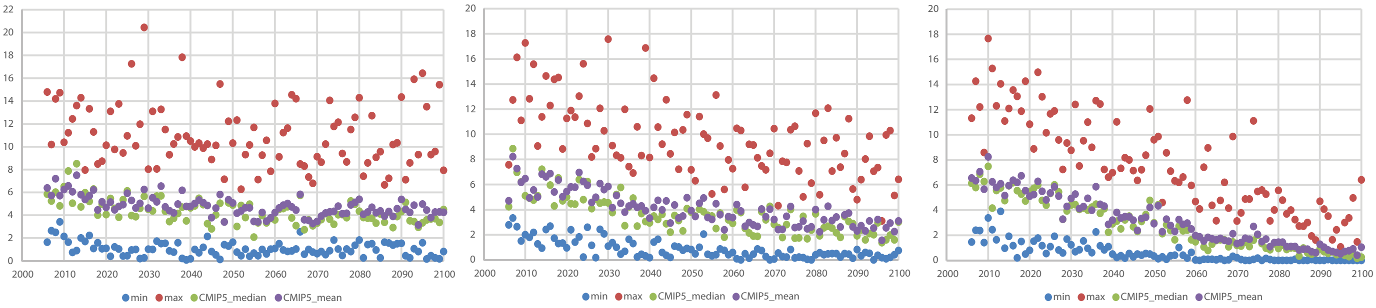


A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-32: Projected CMIP5 14 GSMs Ensemble Cold Nights (TN10p), % Development throughout the Republic of Moldova.

Changes in night time temperature indices TN10p and TN90p are projected to be stronger than those in daytime temperature indices TX10p and TX90p. The TN10p and TX10p decreases are expected of about 4% (under RCP2.6) and/or 7% (under RCP8.5) by the end of this century. Projection from different models converge as the projection approaches the zero exceedance rate (all models project fewer and fewer cold nights and days toward the end of the century, **Table 5-12**.

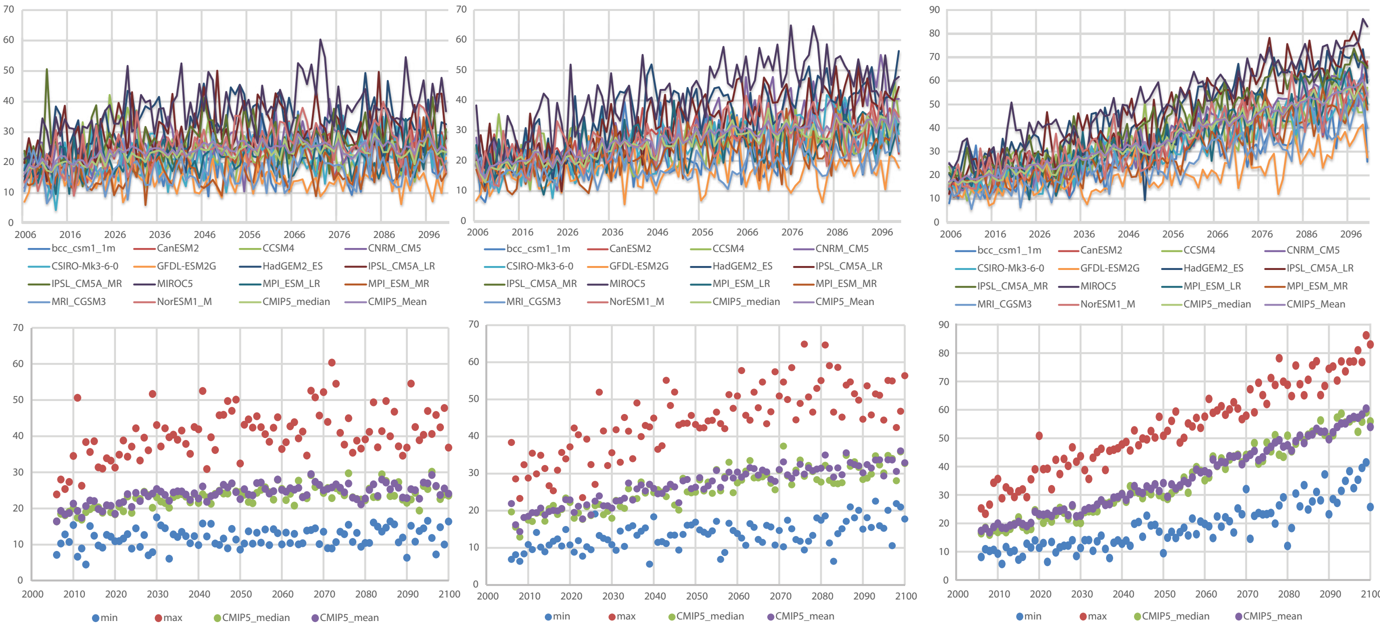




A) RCP2.6 B) RCP4.5 C) RCP8.5

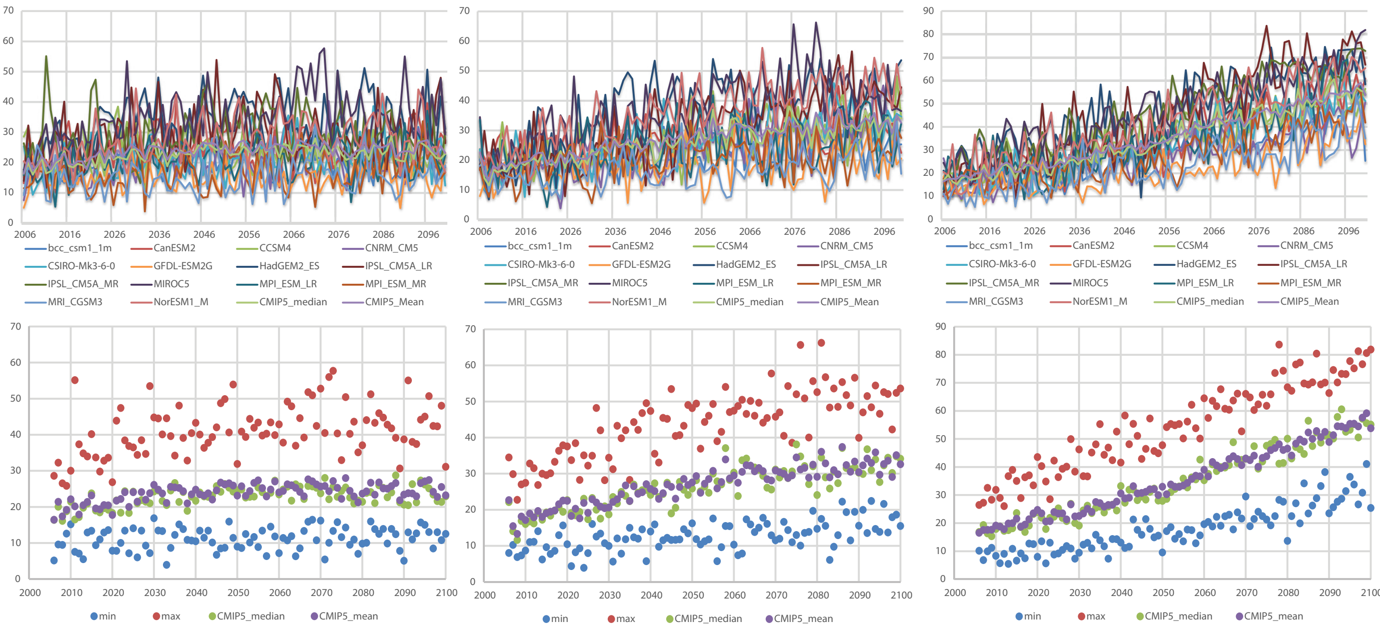
Figure 5-33: Projected CMIP5 14 GSMs Ensemble Cold days (TX10p), % Development throughout the Republic of Moldova.

For the TN90p and TX90p, the median projected increases are from about +14-16% for 1986-2005 and 12.5-13.7% to 35-40% and 36-39% under RCP8.5 scenario by the end of the twenty-first century. That is, hot temperatures that occurred once every day in the late twentieth century would become everyday weather by the end of the twenty-first century under RCP8.5 emission scenario. According to the optimistic RCP2.6 scenario, the median projected increases for TN90p and TX90p are by +10-12% for both of indices, this is lower than in the reference period 1986-2005, **Table 5-12**.



A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-34: Projected CMIP5 14 GSMs Ensemble Warm nights (TN90p), % Development throughout the Republic of Moldova.



A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-35: Projected CMIP5 14 GSMs Ensemble Warm days (TX90p), % Development throughout the Republic of Moldova.

5.2.4.3. Projections of Future Changes in Precipitation Extreme Indices by the CMIP5 Multi-Model Ensemble

The simple daily intensity index (SDII) for baseline climate 1986-2005 has varied in average from 6.7 mm in the north to 7.1 mm in the south of the country. In the **Table 5-13** changes in precipitation indices are expressed as percentage change relative to the reference period 1986-2005. The **Figure 5-36** shows the temporal evolution of simple daily intensity index (SDII) throughout the Republic of Moldova for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, the ensemble median and mean, and maximum, minimum of models spread over 2006-2100 years. Under RCP4.5 and RCP2.6 scenarios, are projected slight increases in PRCPTOT and SDII, whereas according to RCP8.5 scenario the decrease in PRCPTOT are projected.

The SDII is projected to increase everywhere by the end of the twenty-first century under all three scenarios, with strong model agreement. The projections indicate that Central AEZ will experience the greatest increase of SDII, with SDII increasing from 4.1 (RCP2.6) to 6.7% (RCP8.5). By the end of the twenty-first century under RCP2.6 scenario, the projected ensemble median of SDII increase will be from 3.1% in Northern to 3.6% in Southern AEZs and/or from 4.1% in Southern to 6.2% in Northern AEZs under RCP8.5 scenario, respectively.

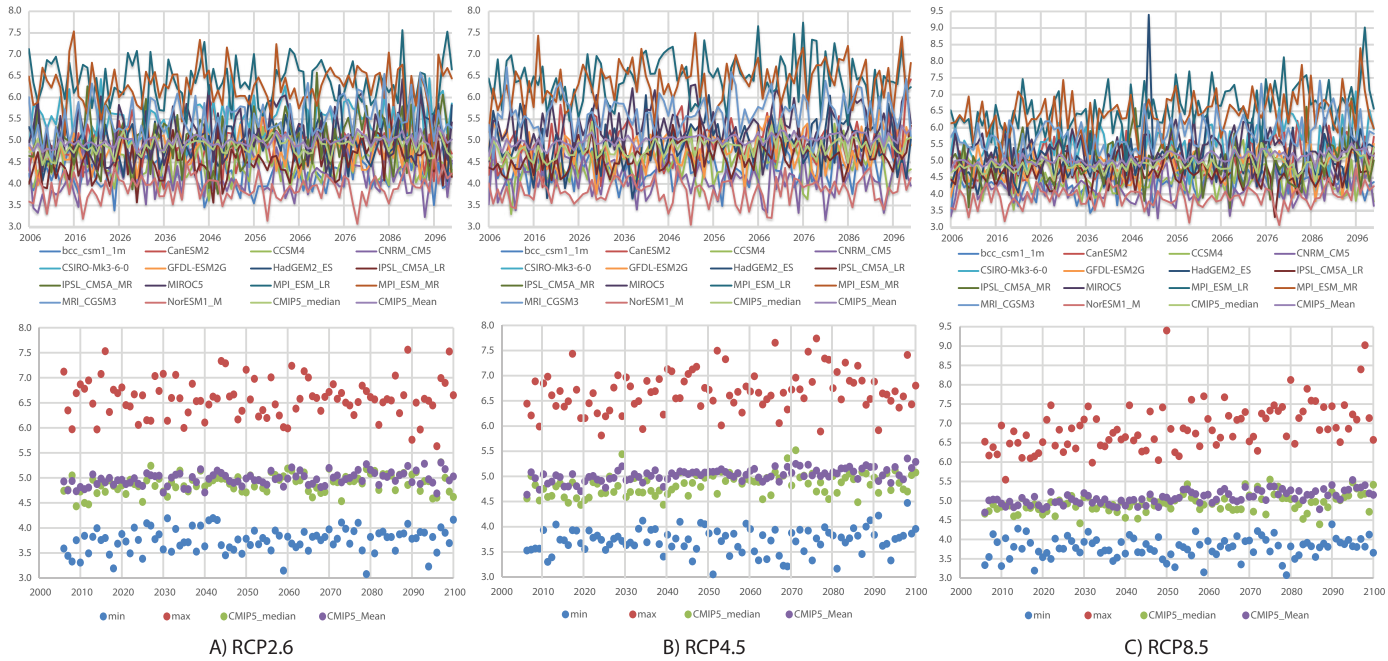
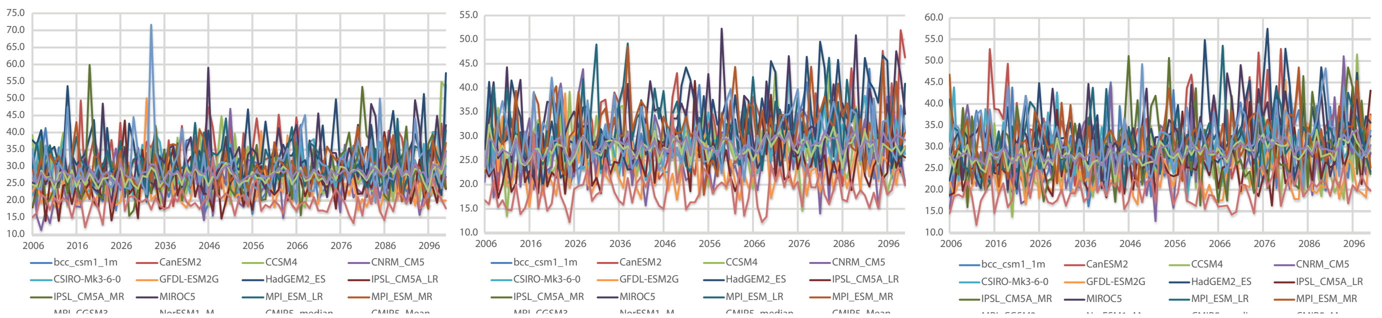
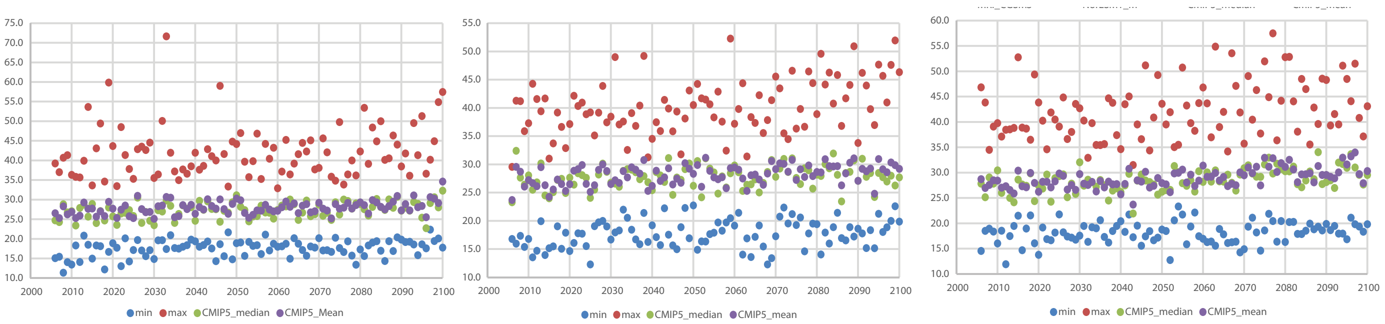


Figure 5-36: Projected CMIP5 14 GSMs Ensemble Simple Daily Intensity (SDII), mm/day Development throughout the Republic of Moldova.

The maximum 1-day precipitation RX1day for baseline climate 1986-2005 have been varied in average from 49.4 mm in the south to 54.5 mm in the north of the country. The **Figure 5-37**, shows the temporal evolution of maximum 1-day precipitation (RX1day) throughout the Republic of Moldova for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, the ensemble median and mean, and maximum, minimum of models spread over 2006-2100 years. The RX1day is projected to increase everywhere by the end of the twenty-first century under all three scenarios. The projections indicate that Central AEZ will experience the greatest increase of RX1day, with RX1day increasing from 4.0 (RCP2.6) to 8.5% (RCP8.5) relative to reference period 1986-2005. By the end of the twenty-first century under RCP2.6 scenario, the projected ensemble median of RX1day increase will be from 2.3% in Northern to 4.8% in Southern AEZs and/or from 6.7% to 8.0%, respectively under RCP8.5 scenario.

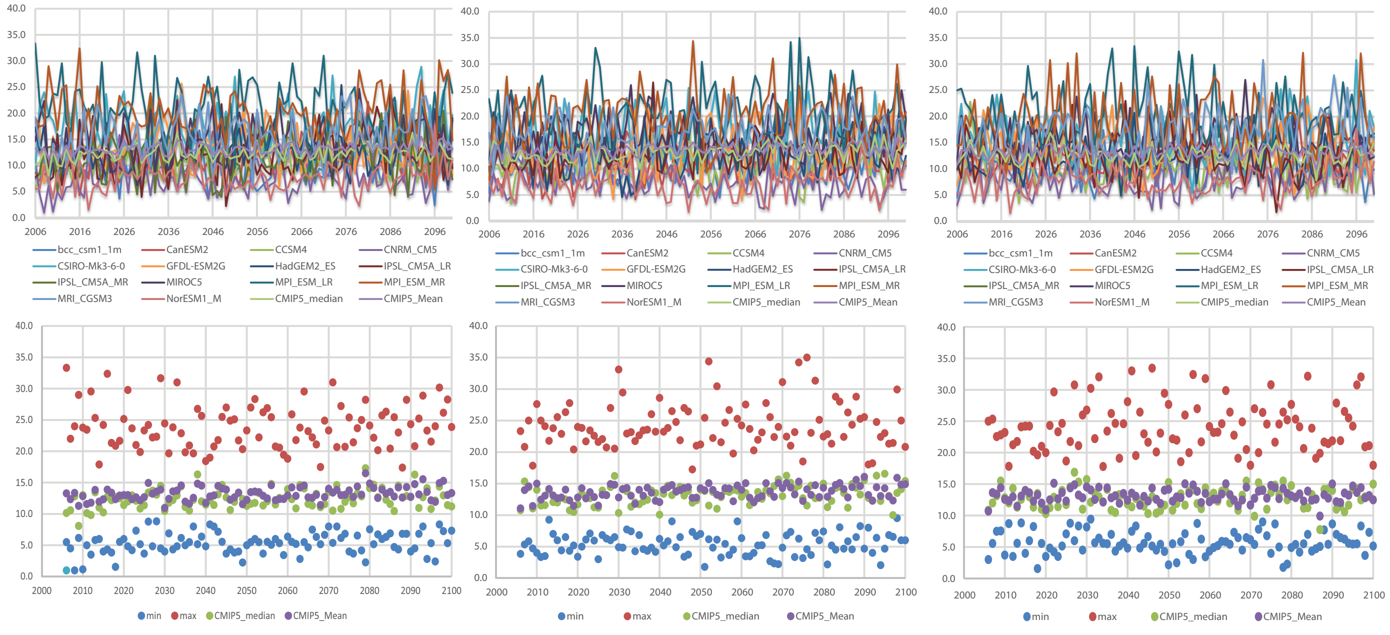




A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-37: Projected CMIP5 14 GSMs Ensemble Maximum 1-Day Precipitation (RX1day), mm, Development throughout the Republic of Moldova.

The **Figure 5-38**, shows the temporal evolution of heavy precipitation days (R10mm), throughout the Republic of Moldova for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, the ensemble median and mean, and maximum, minimum of models spread over 2006-2100 years. The heavy precipitation days, R10mm for baseline climate 1986-2005 have been varied in average from 13.6 days in the south to 16.9 days in the north of the country.

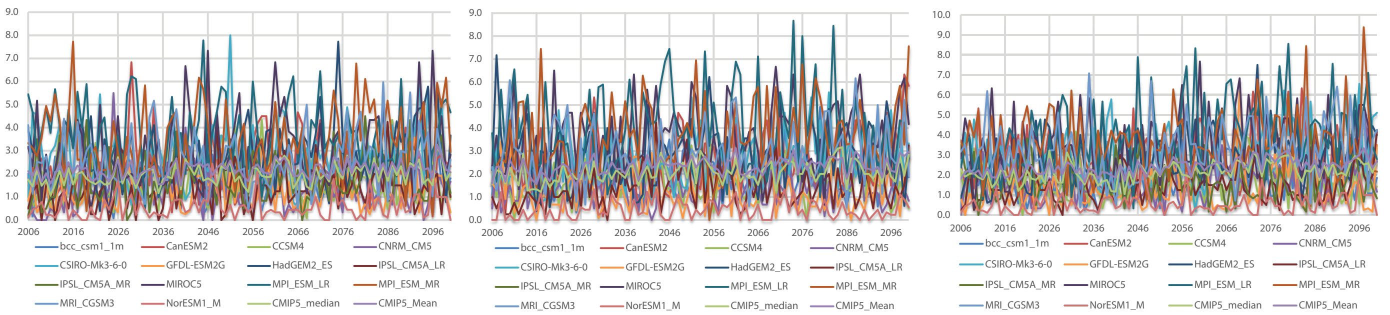


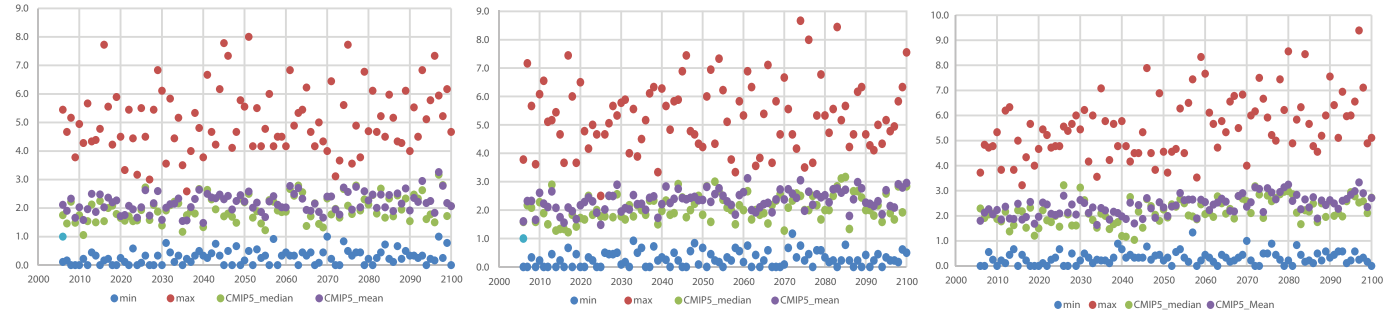
A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-38: Projected CMIP5 14 GSMs Ensemble Heavy Precipitation Days (R10mm), days, Development throughout the Republic of Moldova.

The R10mm is projected to increase everywhere by the end of the twenty-first century under all three scenarios, except Southern AEZ under RCP8.5 scenario. The projections indicate that Central AEZ will experience the greatest increase of the R10mm, with R10mm increasing from 3.0 (RCP2.6) to 10.9% (RCP4.5) relative to reference period 1986-2005. By the end of the twenty-first century under RCP2.6 scenario, the projected ensemble median of R10mm increase will be from 4.1% in Northern to 9.6% in Southern AEZs and/or by 9-10%, respectively under RCP4.5 scenario, **Table 5-13**.

The very heavy precipitation days (R20mm), for baseline climate 1986-2005 have varied on the average from 4.5 days in the south to 5.6 days in the north of the country. The **Figure 5-39**, shows the temporal evolution of R20mm throughout the Republic of Moldova for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, the ensemble median and mean, maximum and minimum of models spread over 2006-2100 years.



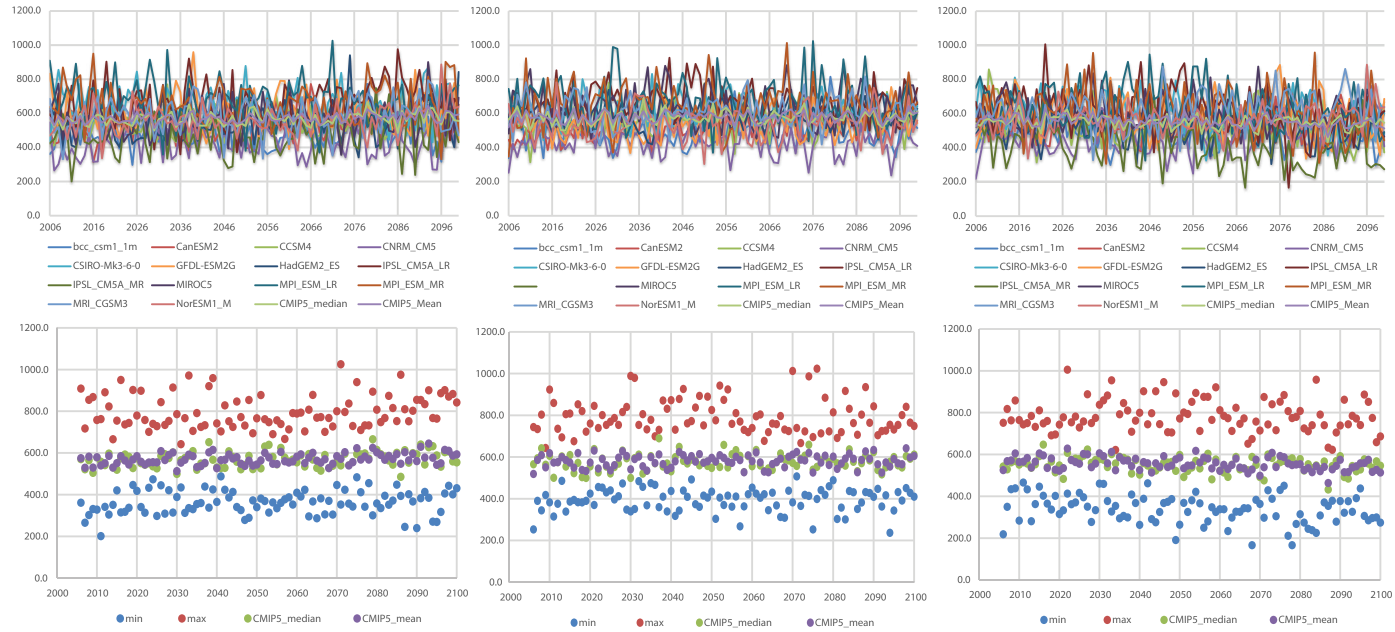


A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-39: Projected CMIP5 14 GSMs Ensemble Very Heavy Precipitation Days (R20mm), days, Development throughout the Republic of Moldova.

The R20mm is projected to increase everywhere by the end of the twenty-first century under all three scenarios. The projections indicate that Northern AEZ will experience the greatest increase of R20mm days, with R20mm increasing from 3.0 (RCP2.6) to 12.5% (RCP8.5) relative to reference period 1986-2005. By the end of the twenty-first century under RCP2.6 scenario, the projected ensemble median of R20mm increase will be from 3% in Northern to 6% in Southern AEZs and/or by 11-12.5%, respectively under RCP8.5 scenario, and medium increase by 8-9% according to RCP4.5 scenario, **Table 5-13**.

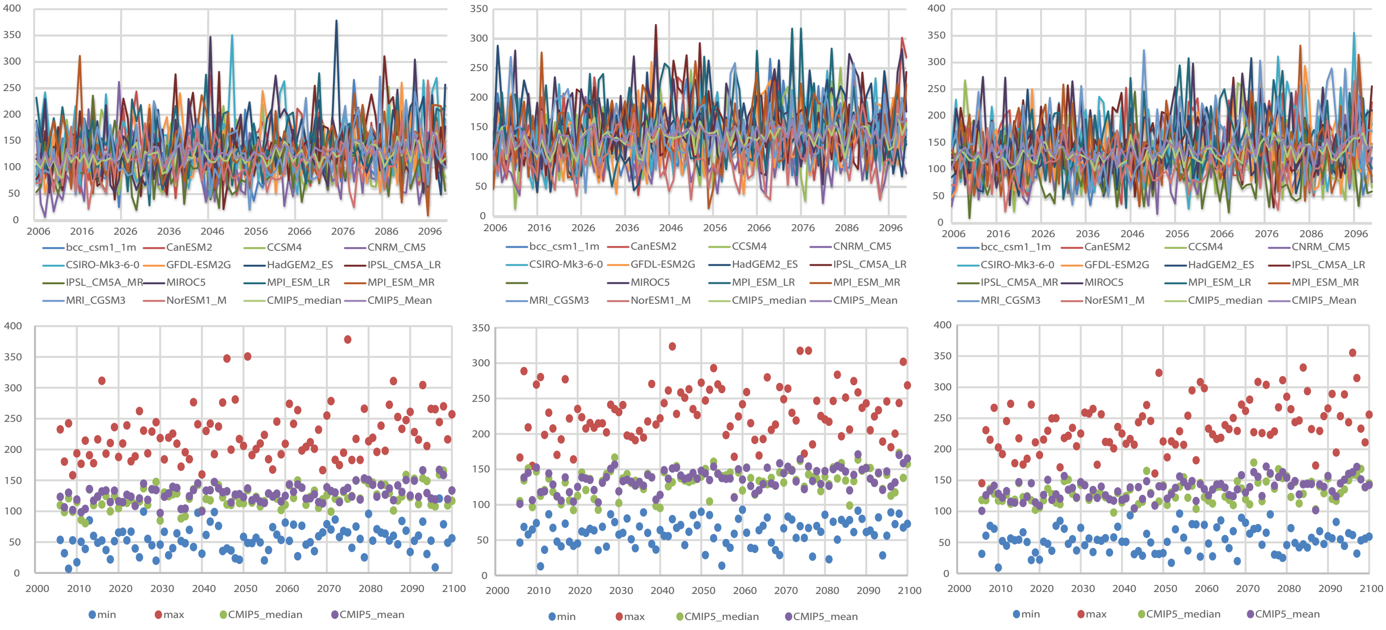
The total wet-day precipitation (PRCPTOT) for baseline climate 1986-2005 have varied on the average from 480.2 mm in the south to 587.29 mm in the north of the country. The **Figure 5-40**, shows the temporal evolution of 95pTOT throughout the Republic of Moldova for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, the ensemble median and mean, maximum and minimum of models spread over 2006-2100 years. The PRCPTOT is projected to decrease everywhere by the end of the twenty-first century under RCP8.5 and to increase according to RCP4.5 and RCP2.6 scenarios. The largest decrease in PRCPTOT is projected in Southern AEZ, with the decrease of PRCPTOT by 9.6%, relative to reference period 1986-2005. The projected PRCPTOT changes have very large spread among models, max +19.2% and min -32.4%. By the end of the twenty-first century, the projected ensemble median of PRCPTOT increase under RCP2.6 scenario will be from 2.6% in Northern to 6.6% in Southern AEZs and/or from 3.6% to 5.2%, respectively under RCP4.5 scenario **Table 5-13**.



A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-40: Projected CMIP5 14 GSMs Ensemble Total Wet-Day Precipitation (PRCPTOT), mm, Development throughout the Republic of Moldova.

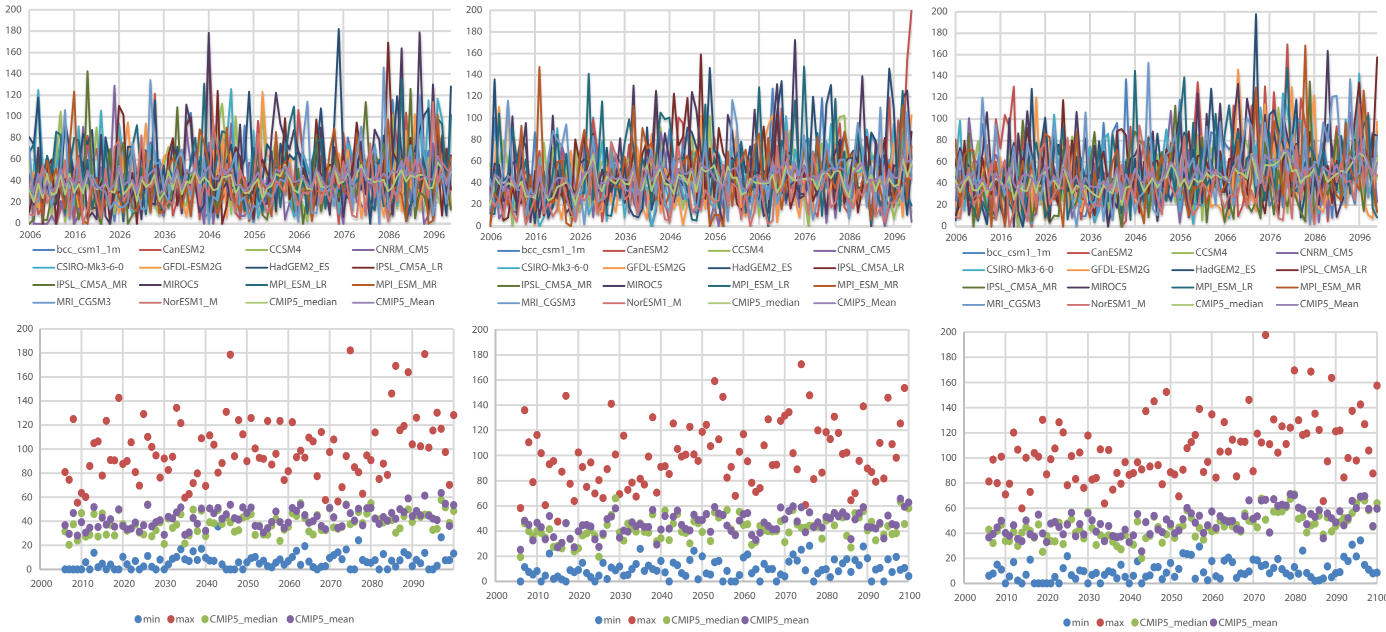
The very wet days (95pTOT) for baseline climate 1986-2005 varied on the average from 135.4 mm in the south to 171.9 mm in the north of the country. The **Figure 5-41,** shows the temporal evolution of 95pTOT throughout the RM for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, the ensemble median and mean, maximum and minimum of models spread over 2006-2100 years. The 95pTOT is projected to increase everywhere by the end of the twenty-first century under all three scenarios. The projections indicate that Northern AEZ will experience the greatest increase of 95pTOT, with 95pTOT by 20% under RCP8.5, whereas Southern AEZ will experience the greatest increase of 95pTOT by 19% under RCP2.6 scenario, relative to reference period 1986-2005. By the end of the XXI century under RCP2.6 scenario, the projected ensemble median of 95pTOT increase will be from 8% in Northern to 19% in Southern AEZs and/or from 14% in Southern to 20% in Northern AEZs, under RCP8.5, and medium increase by 17-18% according to RCP4.5 scenario, **Table 5-13**.



A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-41: Projected CMIP5 14 GSMs Ensemble Very Wet Days (95pTOT), mm, Development throughout the Republic of Moldova.

The extremely wet days (99pTOT) for baseline climate 1986 -2005 varied on the average from 84.5 mm in the south to 104.1 mm in the north of the country. The **Figure 5-42**, shows the temporal evolution of 99pTOT throughout the Republic of Moldova for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, the ensemble median and mean, maximum and minimum of models spread over 2006-2100 years.



A) RCP2.6 B) RCP4.5 C) RCP8.5

Figure 5-42: Projected CMIP5 14 GSMs Ensemble Extremely Wet Days (99pTOT), mm, Development throughout the Republic of Moldova.

The 99pTOT is projected to increase everywhere by the end of the twenty-first century under all three scenarios. As in case with 95pTOT, the projections indicate that Northern AEZ will experience the greatest increase of 99pTOT, with 99pTOT by 10% under RCP8.5 scenario, whereas Southern AEZ will experience the greatest increase of 99pTOT by 19% under RCP2.6 scenario, relative to reference period 1986-2005. By the end of the twenty-first century under RCP2.6 scenario, the projected ensemble median of 99pTOT increase will be from 6.8% in Northern to 10% in Southern AEZs and/or from 18.3% in Southern to 21% in Northern AEZs, under RCP8.5, and medium increase by 13-15 % according to RCP4.5 scenario, **Table 5-13**.

Table 5-13: Projected CMIP5 14 GSMs Ensemble Changes in Precipitation Extreme Indices Presented for 2081–2100 years, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, Relative to the 1986–2005 Climatological Baseline Period

Scenario	Ensemble	RX1day	SDII	R10mm	R20mm	PRCPTOT	R95pTOT	R99pTOT	CDD	CWD
Northern AEZ										
RCP8.5	Average	6.2	6.4	6.4	12.6	-2.1	20.2	19.4	19.8	-16.4
	Median	**6.7**	**6.2**	**2.9**	**12.5**	**-6.8**	**20.2**	**21.1**	**17.3**	**-21.4**
	min	-0.7	2.2	-9.2	-0.3	-18.9	-2.0	-1.0	-13.7	-52.9
	max	13.0	10.5	27.8	25.9	25.5	42.5	35.6	59.6	26.0
	25%	4.4	4.5	-0.9	4.9	-11.4	9.6	15.5	5.5	-35.8
	75%	7.5	8.8	11.6	19.8	10.7	30.3	24.4	33.3	4.4
RCP4.5	Average	4.3	4.7	10.9	9.8	4.2	19.5	14.3	4.5	-3.5
	Median	**5.9**	**4.8**	**9.8**	**8.2**	**3.6**	**17.8**	**14.8**	**3.1**	**-12.5**
	min	-2.0	0.2	-6.4	-6.2	-12.3	9.4	-4.0	-24.4	-27.0
	max	8.1	7.8	29.3	28.6	17.7	38.5	30.1	42.4	46.2
	25%	3.2	4.1	4.3	4.0	-1.7	10.7	8.1	-1.1	-18.2
	75%	6.8	5.2	19.2	17.0	12.3	24.2	19.5	7.2	8.1
RCP2.6	Average	2.3	3.0	7.2	5.6	4.8	10.7	5.5	1.8	2.1
	Median	**2.3**	**3.1**	**4.1**	**2.9**	**2.6**	**8.1**	**6.8**	**2.1**	**-3.4**
	min	-7.1	-2.9	-5.6	-1.3	-3.7	-3.8	-10.2	-18.3	-30.1
	max	9.6	6.3	24.9	19.6	20.8	29.1	22.5	18.8	45.2
	25%	0.9	2.1	3.2	1.3	-0.4	1.2	0.8	-2.8	-15.2
	75%	3.7	4.2	9.5	10.3	9.6	18.2	9.5	8.2	21.2
1986-2005	Average	**54.5**	**6.7**	**16.9**	**5.6**	**587.2**	**171.9**	**104.1**	**24.4**	**5.2**
Central AEZ										
RCP8.5	Average	8.1	6.5	1.7	12.4	-2.7	18.6	21.3	16.5	-13.0
	Median	**8.5**	**6.7**	**3.1**	**9.1**	**-6.5**	**16.0**	**18.5**	**9.4**	**-11.2**
	min	-2.6	0.8	-36.9	0.4	-24.9	0.2	0.3	-17.0	-55.8
	max	14.2	11.9	26.7	33.8	24.6	47.2	48.9	44.8	25.4
	25%	7.4	3.4	-5.8	5.7	-14.2	9.1	13.2	6.2	-32.5
	75%	9.9	9.2	13.0	17.4	8.6	25.7	30.8	36.1	3.8
RCP4.5	Average	5.7	5.1	9.6	8.7	3.3	18.0	15.1	8.7	-3.2
	Median	**5.7**	**5.7**	**10.9**	**9.1**	**4.0**	**16.9**	**13.0**	**2.3**	**-3.5**
	min	-0.4	1.8	-4.4	-1.5	-7.3	5.6	3.1	-14.1	-26.2
	max	17.5	7.9	18.9	19.7	12.8	28.9	38.5	36.4	25.4
	25%	2.9	3.7	7.2	1.9	0.0	14.1	6.8	-0.1	-9.6
	75%	6.9	6.4	14.0	13.0	8.1	23.6	22.5	19.9	0.4
RCP2.6	Average	4.8	3.5	6.7	6.3	5.0	12.5	11.4	1.4	-3.0
	Median	**4.0**	**4.1**	**7.4**	**4.2**	**3.7**	**12.5**	**9.2**	**2.5**	**-1.6**
	min	1.4	0.1	-3.5	-5.9	-4.4	1.4	-3.2	-16.1	-33.8
	max	14.4	7.0	22.1	21.7	18.7	26.9	31.7	11.6	39.1
	25%	2.9	1.1	0.0	2.1	-0.8	3.7	4.1	-2.4	-18.1
	75%	5.4	5.4	11.8	9.4	9.0	19.9	16.6	7.0	9.3
1986-2005	**Average**	**51.9**	**7.2**	**16.0**	**5.5**	**532.5**	**161.5**	**95.7**	**33.3**	**5.2**
Southern AEZ										
RCP8.5	Average	7.6	4.2	-1.9	10.6	-8.6	15.3	17.2	23.3	-17.7
	Median	**8.0**	**4.1**	**-2.9**	**11.4**	**-9.6**	**13.9**	**18.3**	**12.5**	**-10.6**
	min	-2.6	-2.3	-29.0	-7.8	-32.4	-11.2	-8.6	-14.8	-104.3
	max	20.4	12.7	20.6	37.4	19.2	46.8	45.3	58.9	33.0
	25%	6.3	2.1	-8.1	1.9	-15.2	4.6	6.0	6.6	-33.8
	75%	9.6	6.7	5.7	18.6	0.6	27.3	26.7	47.9	1.2
RCP4.5	Average	5.9	3.1	8.6	8.9	1.9	18.2	14.9	11.3	-1.1
	Median	**5.9**	**2.7**	**9.2**	**8.9**	**5.2**	**17.6**	**13.8**	**7.8**	**2.1**
	min	0.0	-0.7	-9.6	-3.3	-8.0	2.5	-1.0	-17.7	-23.4
	max	18.5	6.9	20.6	21.5	12.0	32.4	39.2	34.6	23.9
	25%	2.7	2.6	6.8	2.2	-3.0	13.6	3.4	-0.1	-13.8
	75%	8.2	3.5	11.0	13.3	6.6	22.0	22.0	26.0	6.5
RCP2.6	Average	6.4	3.1	8.2	9.2	6.1	19.1	16.5	1.1	1.5
	Median	**4.8**	**3.6**	**9.6**	**5.9**	**6.6**	**19.1**	**10.1**	**-1.6**	**3.7**
	min	-2.6	-0.9	-9.2	-6.7	-3.4	-4.0	-3.4	-14.5	-31.9
	max	20.6	7.3	21.1	35.6	18.2	46.2	49.1	21.6	41.5
	25%	2.3	0.8	2.8	2.5	0.0	8.5	3.6	-4.9	-7.8
	75%	10.3	4.9	14.9	11.9	9.7	26.7	25.8	5.9	13.1
1986-2005	**Average**	**49.4**	**7.1**	**13.6**	**4.5**	**480.2**	**135.4**	**84.5**	**34.4**	**4.7**

The percentage increase in R95pTOT and R99pTOT is larger than that of PRCPTOT, implying a disproportionally larger contribution to the total precipitation change from an increase in precipitation falling on very wet and extremely wet days. Additionally, models have better agreement in the sign of projected changes in R95pTOT and R99pTOT than in PRCPTOT.

The consecutive dry days (CDD) for baseline climate 1986-2005 varied on the average from 24.4 days in the north to 34.4 days in the south of the country. The **Figure 5-43,** shows the temporal evolution of CDD throughout the Republic of Moldova for CMIP5 14 individual GCMs, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, the ensemble median and mean, maximum and minimum of models spread over 2006-2100 years.

The CDD is projected to increase everywhere by the end of the twenty-first century under all three scenarios, except Southern AEZ where the slight decrease in consecutive dry days is possible under RCP2.6 low scenario. The projections indicate that Northern AEZ will experience the greatest increase of CDD, by 17% under RCP8.5 scenario, whereas Southern AEZ will experience the decrease of CDD by -1.6% under RCP2.6 scenario, relative to reference period 1986-2005. By the end of the twenty-first century under RCP4.5 scenario, the projected ensemble median of CDD increase will be from 3.1% in Northern to 7.8% in Southern AEZs and/or from 12.5% in Southern to 17% in Northern AEZs, under RCP8.5 scenario, **Table 5-13**.

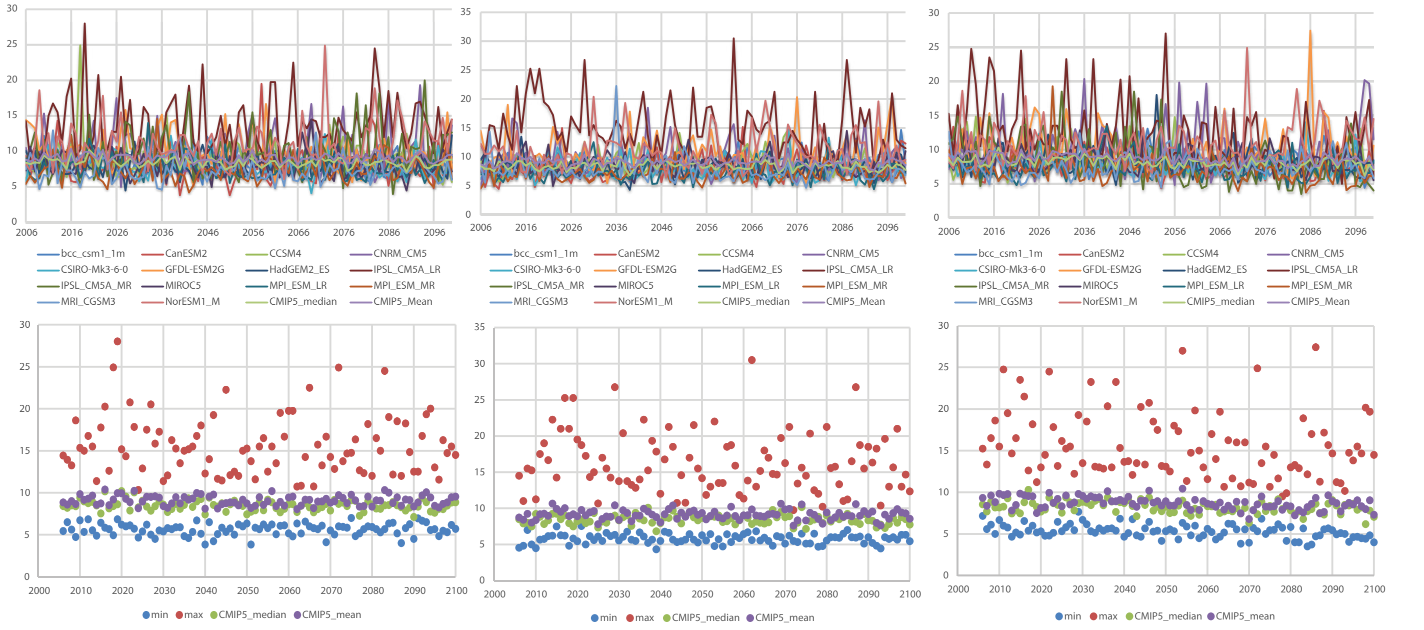
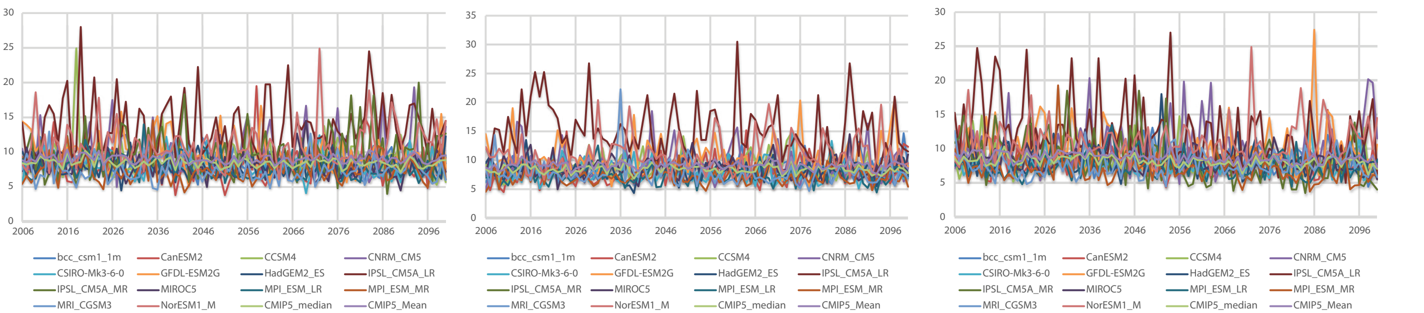
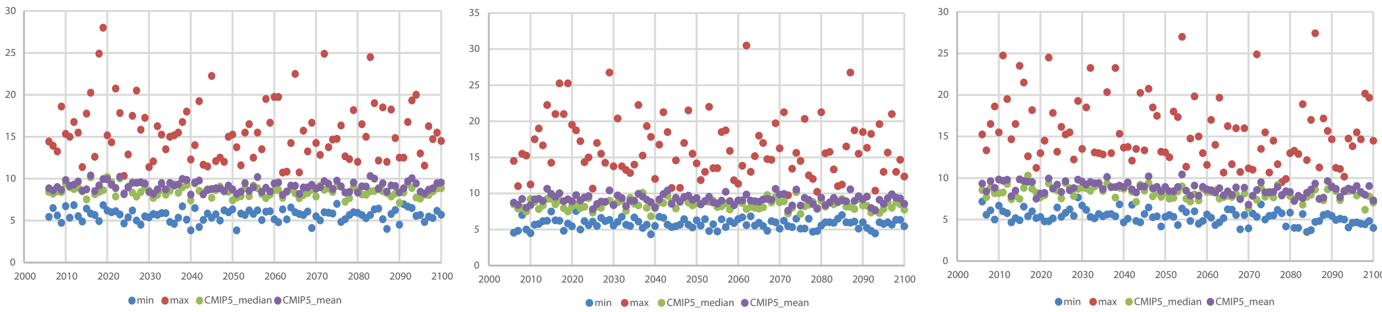


Figure 5-43: Projected CMIP5 14 GSMs Ensemble Consecutive Dry Days (CDD), Days, Development throughout the Republic of Moldova.

The consecutive wet days (CWD) for baseline climate 1986 -2005 varied on the average from 4.7 days in the south to 5.2 days in the north of the country. The **Figure 5-44**, shows the temporal evolution of CWD throughout the Republic of Moldova for 14 individual CMIP 5 GCMs, under Representative Concentration Pathways RCP 2.6, RCP4.5, RCP 8.5, the ensemble median and mean, maximum and minimum of models spread over 2006-2100 years.





A) RCP2.6　　B) RCP4.5　　C) RCP8.5

Figure 5-44: Projected CMIP5 14 GSMs Ensemble Consecutive Wet Days (CWD), days, Development throughout the Republic of Moldova.

The CWD is projected to decrease everywhere by the end of the twenty-first century under all three scenarios, except Southern AEZ where the slight increase in consecutive wet days is possible under RCP4.5 medium and RCP2.6 low scenarios. The projections indicate that Northern AEZ will experience the greatest decrease of CWD by 21% under RCP8.5 scenario, whereas Southern AEZ will experience the slight increase of CWD by +2.1% (RCP4.5) and/or +3.7% (RCP2.6) scenarios, relative to reference period 1986-2005. By the end of the twenty-first century under RCP4.5 scenario, the projected ensemble median of CWD decrease will be from 3.5% in Central to 12.5% in Northern AEZs and/or from 10.6% in Southern to 21% in Northern AEZs, under RCP8.5 scenario.

5.3. Climate Change and Agroclimatic Conditions

5.3.1. Climate Change and Thermal Resources

5.3.1.1. Data and Methods

In this study, thermal agroclimatic indices were calculated from daily climatic observed data for a baseline period 1986-2005, and for three future 20-yr time periods (2016–2035, 2046–2065, and 2081-2100) based on projections of changes in temperature received by regionalization of global experiments the most reliable for the RM CMIP5 21 GCMs for three Representative Concentration Pathways RCP8.5, RCP4.5 and RCP2.6. In **Table 5-14** are presented the definitions of the agroclimatic indices analyzed in this study.

Table 5-14: The definitions of agro-climatic indices have been used in the assessment

Indices	Abbreviation	Definition	Unit
Last frost day	**LFD**	Date of last spring frost	Date
First frost day	**FFD**	Date of first autumn frost	Date
Frost period	**FP**	Number of days between *FFD* and *LFD*	Date
Frost-free period	**FFP**	Number of days between *LFD* and *FFD*	Days
Start of Growing Season	$\mathbf{GSS}_{5,\,10,\,\text{and}\,15°C}$	The earliest date of series of days with the mean daily air temperature of ≥ 5, 10 and 15°C that is the beginning of such cumulated series of daily mean temperature deviations from the threshold value of 5, 10 and 15°C that do not have negative values up to the end of the first 6 month of the year.	Date
End of Growing Season	$\mathbf{GSE}_{5,\,10,\,\text{and}\,15°C}$	A day directly preceding the earliest date after the beginning of $GSE_{5,\,10,\,and\,15°C}$ of a series of days with the mean daily air temperature of ≤ 5, 10 and 15°C that is the beginning of such cumulated series of daily mean temperature deviations from the threshold value of 5, 10 and 15°C that do not have positive values up to the end of a year.	Date
Length of Growing Season	$\mathbf{LGS}_{5,\,10,\,\text{and}\,15°C}$	Number of days between $GSS_{5,\,10,\,15°C}$, and $GSE_{5,\,10,\,15°C}$	Days
Active Growing Degree Days	$\mathbf{AGDD}_{5,\,10,\,\text{and}\,15°C}$	Accumulated sum of temperature degrees above 5°C, 10°C, and 15°C	°C
Effective Growing Degree Days	$\mathbf{EGDD}_{5,\,10,\,\text{and}\,15°C}$	Accumulated sum of temperature degrees above 5°C, 10°C, and 15°C minus T_{base}	°C

In the case of frost-based indices, the first frost day (*FFD*) and last frost day (*LFD*), the frost period (*FP*) and the number of frost days (*NFD*), we used the 0°C thresholds. Producers traditionally determine the actual length of a growing season and the suitable dates for planting and harvesting field crops by the number of frost-free days (*FFP*), which include period between the date of the last spring frost (*LFD*), and the date of the first fall frost (*FFD*), respectively. A day with average temperature above than 0°C is considered a frost-free day, as frost often occurs when daily average temperature is below 0°C.

The length of the growing season (*LGS*) is another widely used index. In general, the 5°C mean temperature (T_{avg}) threshold is widely accepted for determining the thermal growing season, in particular for mid and high latitudes (Carter 1998; Frich et al., 2002; Jones et al., 2002, Menzel et al., 2003). In our study, $LGS_{5,\,10,\,and\,15°C}$ is defined as the period from the growing season start ($GSS_{5,\,10,\,and\,15°C}$) to the growing season end (GSE). The $GSS_{5,\,10,\,and\,15°C}$ is the earliest date of series of days with the mean daily air temperature of ≥ 5, 10 and 15°C that is the beginning of such cumulated series of daily mean temperature deviations from the threshold value of 5, 10 and 15°C that do not have negative values up to the end of the first 6 month of the year. The $GSE_{5,\,10,\,and\,15°C}$ in a given year is a day directly preceding the earliest date after the beginning of $GSE_{5,\,10,\,and\,15°C}$ of a series of days with the mean daily air temperature of ≤ 5, 10 and 15°C that is the beginning of such cumulated series of daily mean temperature deviations from the threshold value of 5, 10 and 15°C that do not have positive values up to the end of a year. The definition of $LGS_{5,\,10,\,and\,15°C}$ is particularly relevant for measuring change of agricultural environment. Crops grow when the daily T_{avg} is above a given temperature threshold, varying according to the specie and its phenological state. Different indices are used to quantify that process.

The active growing degree day ($AGDD_{5, 10, and 15°C}$) and effective growing degree day ($EGDD_{5, 10, and 15°C}$) has been used to assist in selections of crops and hybrids to assure the selected crops will achieve maximum growth at the time they reach maturity and potential yield. The $AGDD_{Tb}$ for three different temperature thresholds (5, 10 and 15°C) was computed according to:

$$AGDD_{T_b} = \sum_{k=1}^{n} \mathrm{T_{avg}}$$

where *n* is the number of days in a given growing season, T_{avg} is the daily average temperature from the start ($GSS_{5, 10, and 15°C}$) to the end ($GSE_{5, 10, and 15°C}$) of the growing season and T_b is the cardinal temperature (5, 10, and 15°C) for initiation and termination of growth for different crop types.

The *EGDD* T_b for three different temperature thresholds or base temperature T_b (5, 10 and 15°C) was computed according to:

$$EGDD_{T_b} = \sum_{k=1}^{n} (T_{avg} - T_b)$$

Where *n* is the number of days in a given growing season, T_{avg} is the daily average temperature from the start ($GSS_{5, 10, and 15°C}$) to the end ($GSE_{5, 10, 15°C}$) of the growing season and T_b is the cardinal temperature 5, 10 and 15°C for initiation and termination of growth for different crop types. There is no accumulation in *EGDD* if $T_{avg} < T_b$ (*Ţăranu*, 2014).

5.3.1.2. Summary of Observed Trends for the Thermal Agroclimatic Indices

I. Frost Indices and Frost – free Period

The last frost day (LFD) occurrence in the spring varied from 16/04 in the North of the country (Briceni) to the 04/04 in the South (Cahul), and the first frost day (FFD) occurrence in the autumn from 16/10 to 27/10, respectively on the average for 1961-2014. Additional information on the temporal and spatial development of FFD and LFD occurrence throughout the RM is presented in **Table 5-15**, **Figure 5-45**. To assess the trends in the change of the last frost day (LFD) occurrence in the spring and first frost day (FFD) occurrence in the autumn over time, the coefficients of the linear trend slope, (CLTS), and the coefficients of its determination, R^2, was calculated. The CLTS values of the LFD occurrence during the spring on the most territory of the RM have a negative sign and varied from -0.17 to -1.75 days/10 years, however the LFD trends in 1961-2014 time period mostly are not statistically significant, with the exception of LFD trends for Falesti, Leova and Comrat ($p \leq 0.1$), R^2 was from 5% to 7%, so a trend can be noted of early start of springs. For some stations, as Balti, Bravicea, Camenca, and Ribnita in 1961-2014 a slight positive trend was observed, in LFD occurrence in the spring, statistically not significant, that varied from +0.13 to +0.86 days/10 years and statistically significant by +3.11 days/10 years in Baltata, the value of the coefficient of determination, R2, amounting to 17%, which shows a trend towards delayed start of spring in these districts, Table 5-15.

Table 5-15: The *LFD* and *FFD*, (Dates), Trend Slope (Days/10 years), Coefficient of Determination, R^2, and Statistical Significance of Changes, *p-value* for 1961-2014

Station	*LFD*	*Trend*	R^2	*p-value*	*FFD*	*Trend*	R^2	*p-value*
Briceni	16/04	-1.45	3	0.1860	16/10	1.75	7	**0.0587**
Soroca	16/04	-0.21	0.0	0.8507	16/10	1.12	3	0.2418
Camenca	17/04	0.15	0.1	0.8863	15/10	-0.77	1	0.4247
Ribnita	17/04	0.81	1	0.4852	11/10	-0.43	0.1	0.6440
Balti	17/04	0.13	0.1	0.8989	15/10	1.43	4	0.1449
Falesti	08/04	-1.75	5	**0.0890**	25/10	1.72	6	**0.0642**
Bravicea	18/04	0.86	1	0.4191	22/10	0.66	1	0.4931
Cornesti	10/04	-1.05	2	0.3064	22/10	1.24	4	0.1640
Dubasari	06/04	-0.17	0.1	0.8437	21/10	1.73	6	**0.0702**
Tiraspol	14/04	0.94	2	0.3198	17/10	0.62	1	0.4250
Baltata	18/04	3.11	17	**0.0017**	13/10	-1.10	3	0.1925
Chisinau	02/04	-1.26	4	0.1310	24/10	2.60	10	**0.0169**
Leova	04/04	-1.37	5	**0.0925**	25/10	1.37	3	0.1964
Comrat	06/04	-0.91	2	0.2832	23/10	0.59	1	0.5320
Cahul	04/04	-1.64	7	**0.0569**	27/10	0.94	2	0.3475

The opposite trend is observed for FFD occurrence in the autumn, the CLTS values of the FFD on most territory of the RM have a positive sign and varied from +0.59 to +2.60 days/10 years, however as in case of the LFD trends they are mostly not statistically significant, with the exception of FFD trends for Chisinau ($p \leq 0.05$), Briceni, Falesti, and Dubasari ($p \leq 0.1$), R^2 was from 6% to 10%, so a trend can be noted of autumn extension. For some stations, in 1961-2014 as Camenca, Ribnita, and Baltata was observed the slight negative trend, in FFD occurrence in the autumn, statistically not significant, that was varied from -0.43 to -1.10 days/10 years, which shows a tendency towards early start of winter in these areas, Table 5-15.

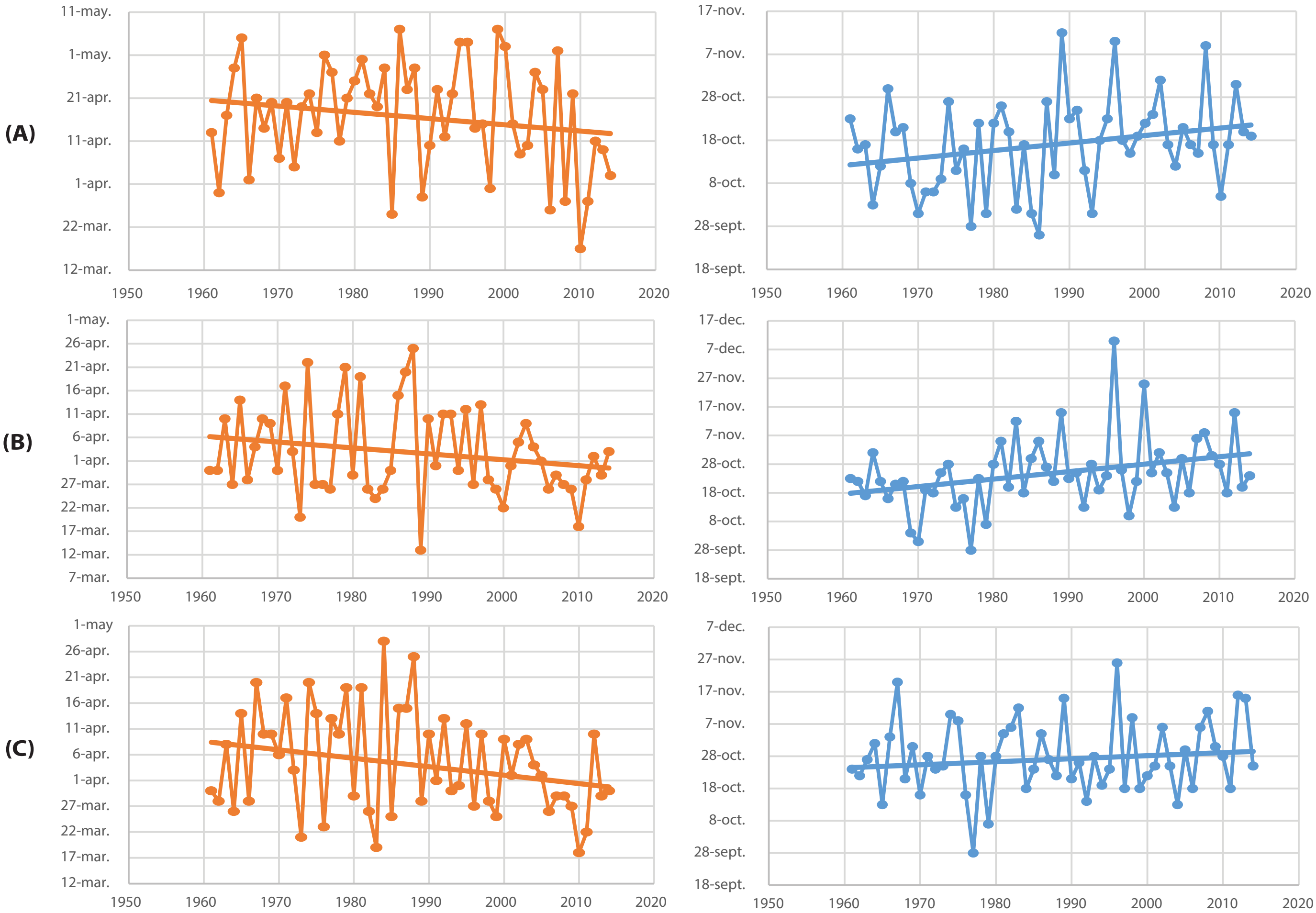


Figure 5-45: The Last Frost Day, LFD (Orange) and First Frost Day, FFD (Blue) Development in 1961-2014 Time Period: (A) Briceni, (B) Chisinau, (C) Cahul.

In the future, due to the *FFD* delay and earliest occurrence of *LFD*, in the RM can be expected a substantial decrease in the FP. The frost-free period, *FFP* and frost period *FP* have been varied from 178 and 187 days in the North of the country (Briceni) to the 206 and 159 days in the South (Cahul), on the average for 1961-2014. Additional information on the temporal and spatial development of the *FFP* and *FP* throughout the RM is presented in **Table 5-16, Figure 5-46**.

As can be seen from **Table 5-16** an increase in the frost - free period, FFP have been observed on the most territory of the RM. The CLTS values of the FFP trends in 1961-2014-time period have had a positive sign and varied from +1.50 to +7.25 days/10 years, and were statistically significant, for Briceni, Falesti, Chisinau, and Leova ($p \leq 0.05$) and Cornesti, Cahul ($p \leq 0.1$), R^2 was from 5% to 12%, which shows a gradual increase in the FFP and correspondingly decrease in frost period, FP in the region. For some stations, as Camenca, Ribnita, Tiraspol, and Bravicea in 1961-2014-time period was observed the slight FFP decreasing trend, statistically not significant, that have varied from -0.32 to -1.23 days/10 years and statistically significant by -4.17 days/10 years in Baltata, with the value of the coefficient of determination, R^2, amounting to 18%, which shows a tendency towards decrease in FFD and correspondingly increasing trend in frost period FP in these districts, **Table 5-16**.

Table 5-16: The *FFP* and *FP*, (Days), Trend Slope (Days /10 years), Coefficient of Determination, R^2, and Statistical Significance of Changes, p-value for 1961-2014

Station	FFP	Trend	R^2	p-value	FP	Trend	R^2	p-value
Briceni	178	7.25	8	**0.0379**	187	-7.25	8	**0.0385**
Soroca	184	1.33	2	0.3683	182	-1.33	2	0.3698
Camenca	181	-0.92	0.1	0.5546	184	0.92	0.1	0.5522
Ribnita	177	-1.23	1	0.4170	188	1.21	1	0.4222
Balti	181	1.30	2	0.3765	185	-1.30	2	0.3729
Falesti	200	3.47	11	**0.0159**	165	-3.46	11	**0.0161**
Bravicea	187	-0.30	0.1	0.8416	179	0.30	0.1	0.8387
Cornesti	195	2.30	5	**0.0984**	170	-2.30	5	**0.0979**
Dubasari	198	1.89	4	0.1381	167	-1.89	4	0.1365
Tiraspol	186	-0.32	0.1	0.7856	179	0.32	0.2	0.7804
Baltata	178	-4.17	18	**0.0014**	188	4.17	18	**0.0014**

Station	FFP	Trend	R^2	p-value	FP	Trend	R^2	p-value
Chisinau	205	3.86	12	**0.0088**	160	-3.85	13	**0.0086**
Leova	203	2.74	7	**0.0500**	162	-2.74	7	**0.0503**
Comrat	199	1.50	3	0.2520	166	-1.50	3	0.2528
Cahul	206	2.58	6	**0.0664**	159	2.57	6	**0.0676**

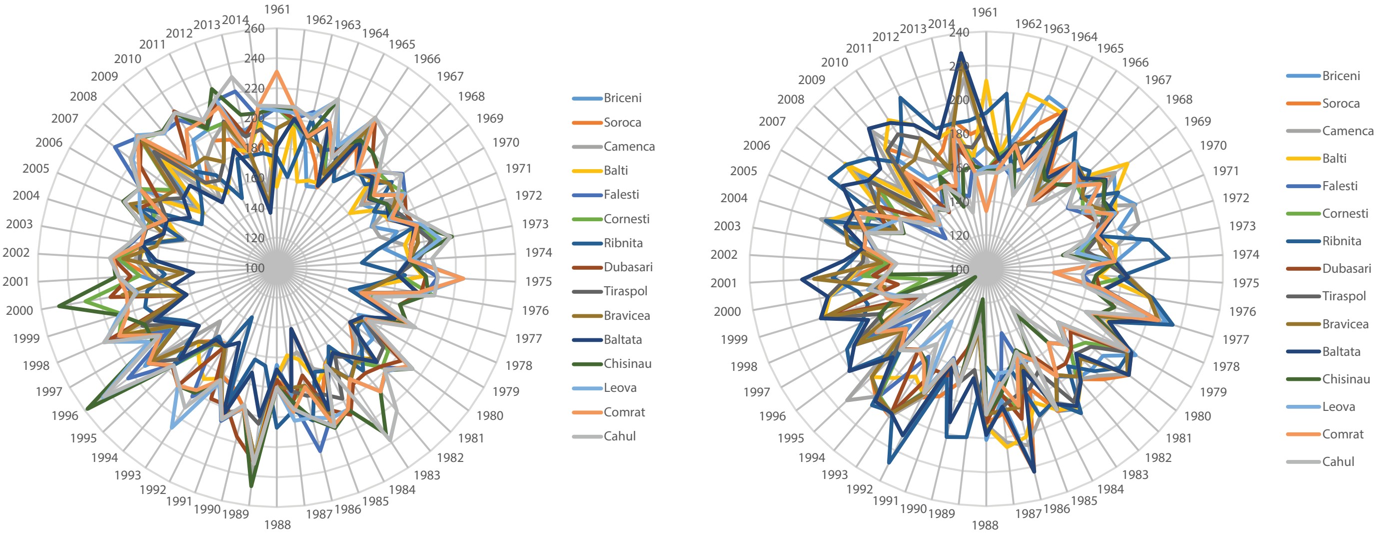


Figure 5-46: The Frost-Free Period, FFP and Frost Period, FP, (Days), Development throughout the RM in 1961-2014 Time Period.

II. Length of the Growing Season, $LGS_{5,\ 10,\ and\ 15°C}$

The start of growing season with average temperatures above 5°C, $GSS_{5°C}$ in the spring have been varied from 21/03 in the North of the country (Briceni) to the 18/03 in the South (Cahul), and the end of growing season with average temperatures above 5°C, $GSE_{5°C}$ date occurrence in the autumn from 07/11 to 15/11, respectively on the average for 1961-2014 years. For comparison, for the 1961-1990 years the $GSS_{5°C}$ and $GSE_{5°C}$ were from 29/03 and 05/11 in the North (Briceni) up to 22/03 and 12/11 in the South (Cahul) (Ţăranu, 2014). Additional information on the temporal and spatial development of $GSS_{5°C}$ and $GSE_{5°C}$ occurrence throughout the RM is presented in **Table 5-17**.

Table 5-17: The $GSS_{5°C}$, $GSE_{5°C}$ (Dates), and $LGS_{5°C}$, (Days), Trend Slope (Days/10 years), Coefficient of Determination, R^2, and Statistical Significance of Changes, *p-value* for 1961-2014

Station	$GSS_{5°C}$	Trend	R^2	p-value	$GSE_{5°C}$	Trend	R^2	p-value	$LGS_{5°C}$	Trend	R^2	p-value
Briceni	21/03	-2.45	4	0.1296	07/11	0.25	0.1	0.8106	226	2.65	5	0.8594
Soroca	23/03	-2.60	13	**0.0065**	08/11	0.03	0.0	0.9771	229	2.65	5	0.1186
Camenca	25/03	-2.21	10	**0.0190**	09/11	0.70	0.7	0.5392	231	2.92	7	**0.0617**
Ribnita	23/03	-2.00	8	**0.0371**	10/11	1.78	5	0.1743	232	3.17	8	**0.0436**
Balti	21/03	-1.63	4	0.1251	12/11	1.34	3	0.2071	234	2.98	6	**0.0641**
Falesti	20/03	-1.98	6	**0.0792**	12/11	1.88	6	**0.0725**	237	3.87	11	**0.0146**
Bravicea	20/03	-1.85	5	0.1079	12/11	0.88	1	0.4323	238	2.74	6	**0.0772**
Cornesti	22/03	-2.15	8	**0.0346**	12/11	1.74	5	0.1063	235	3.91	12	**0.0119**
Dubasari	20/03	-2.03	6	**0.0653**	14/11	1.42	3	0.1814	240	3.80	10	**0.0198**
Tiraspol	20/03	-1.71	4	0.1357	16/11	0.52	0.4	0.6378	241	2.24	4	0.1695
St-Voda	22/03	-1.12	2	0.4776	13/11	0.42	0.3	0.6947	236	1.55	2	0.3417
Baltata	20/03	-1.93	5	**0.0922**	13/11	1.46	3	0.1819	238	3.42	9	**0.0295**
Chisinau	20/03	-1.86	5	0.1037	13/11	1.53	4	0.1411	238	3.42	9	**0.0272**
Leova	20/03	-1.76	5	0.1159	14/11	-0.31	0.2	0.7698	240	1.46	2	0.3085
Comrat	19/03	-1.83	5	0.1167	15/11	1.01	2	0.3187	241	2.87	6	0.0696
Cahul	18/03	-1.76	4	0.1332	15/11	0.38	0.3	0.7133	241	2.17	4	0.1636

The start of growing season with average temperatures above 5°C, ($GSS_{5°C}$) have decreasing trend during the 1961-2014 over the RM. The *CLTS* values of the $GSS_{5°C}$ trends in 1961-2014-time period have had a negative sign and varied from -1.76 to -2.60 days/10 years, and were statistically significant, for Soroca, Camenca, Ribnita, and Cornesti ($p \leq 0.05$) and Falesti, Dubasari, Baltata ($p \leq 0.1$), R^2 was from 5% to 13%, so it can be noted about a tendency to early start of $GSS_{5°C}$ in spring. During the 1961-2014 the increasing trend for end of growing season ($GSE_{5°C}$) was observed, statistically not significant, that have varied from +0.25 to +1.78 days/10 years and statistically significant by +1.88 days/10 years in Falesti ($p \leq 0.1$), with the value of the coefficient of determination, R^2, amounting to 6%, which shows a tendency towards later end of growing seasons GSE5°Cand over the RM, **Table 5-17**.

The opposite tendency is observed for end of growing season with average temperatures above 5°C, $GSE_{5°C}$ date occurrence in the autumn, the *CLTS* values of the $GSE_{5°C}$ on the most territory of the RM have a positive sign and varied from +0.25

to +1.78 days/10 years, however as in case of the *FFD* trends they are mostly not statistically significant, with the exception of $GSE_{5°C}$ trend for Falesti, ($p \leq 0.1$), with R^2 accounting to 6%, so it can be noted only about a tendency to later date of $GSE_{5°C}$, **Table 5-17**.

The length of growing season with average temperatures above 5°C, $LGS_{5°C}$ varied from 226 days in the North of the country (Briceni) to 241 days in the South (Cahul) on the average for 1961-2014 years. For comparison, for the 1961-1990 years the $LGS_{5°C}$ was from 222 days in the North (Briceni) up to 246 in the South (Cahul), (Ţăranu, 2014). Additional information on the temporal and spatial development of $LGS_{5°C}$ throughout the RM is presented in **Table 5-17**, and **Figure 5-47**.

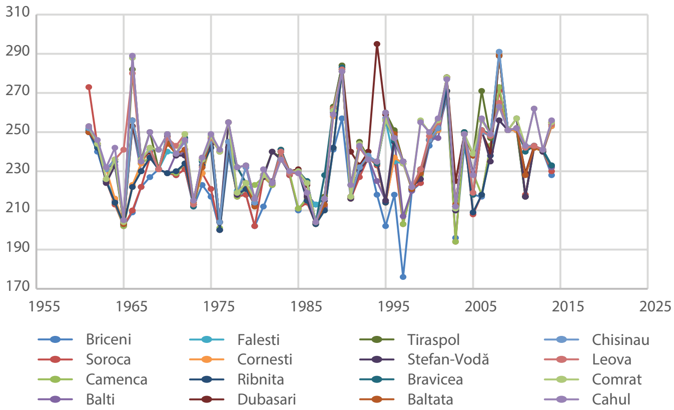


Figure 5-47: The Length of Growing Season, $LGS_{5°C}$ (Days), Development throughout the RM in 1961-2014 Time Period.

As can be seen from **Table 5-17** an increase in the length of growing season with average temperatures above 5°C, $LGS_{5°C}$, have been observed over all territory of the RM. The *CLTS* values of the $LGS_{5°C}$ trends in 1961-2014-time period have had a positive sign and varied from +1.46 to +3.91 days/10 years, and were statistically significant, for Falesti, Ribnita, Cornesti, Dubasari, Chisinau, and Baltata ($p \leq 0.05$) and Balti, Camenca, Bravicea, and Comrat ($p \leq 0.1$), R^2 was from 6% to 12%, which shows a gradual increase in the $LGS_{5°C}$ in the region.

The start of growing season with average temperatures above 10°C, $GSS_{10°C}$ in the spring has varied from 19/04 in the North of the country (Briceni) to the 13/04 in the South (Cahul), and the end of growing season with average temperatures above 10°C, $GSE_{10°C}$ has occurred in autumn from 11/10 to 21/10, respectively on the average for 1961-2014 years. For comparison, for the 1961-1990 years the $GSS_{10°C}$ and $GSE_{10°C}$ were from 22/04 and 10/10 in the North (Briceni) up to 21/04 and 19/10 in the South (Cahul), (Ţăranu, 2014). Additional information on the temporal and spatial development of $GSS_{10°C}$ and $GSE_{10°C}$ occurrence throughout the RM is presented in **Table 5-18**.

The start of growing season with average temperatures above 10°C, ($GSS_{10°C}$) during the 1961-2014 has a decreasing trend over the RM. The *CLTS* values of the $GSS_{10°C}$ trends in 1961-2014-time period have had a negative sign and varied from -0.25 to -1.26 days/10 years, however they are not statistically significant, which shows only a trend towards early start of the growing season with average temperatures above 10°C, $GSE_{10°C}$ over the RM.

The opposite tendency has been observed for the end of growing season with average temperatures above 10°C, ($GSE_{10°C}$) in autumn during the 1961-2014 on the most territory of the RM. The *CLTS* values of the $GSE_{10°C}$ trends in 1961-2014-time period have had a positive sign and varied from +0.32 to +2.22 days/10 years, and were statistically significant, for Dubasari ($p \leq 0.05$), Falesti, Bravicea, Cornesti, and Comrat ($p \leq 0.1$), R^2 was from 5% to 9%, so a slight trend can be noted towards later end of growing season with average temperatures above 10°C, $GSE_{10°C}$ in autumn. For some north stations, such as Briceni, Soroca, Balti, Camenca, in 1961-2014 period a slight $GSE_{10°C}$ decreasing trend was observed, statistically not significant, that has varied from -0.19 to -0.92 days/10 years, which shows a slight trend towards an early end of growing season with average temperatures above *10°C*, $GSE_{10°C}$ in these districts, Table 5-18.

Table 5-18: The $GSS_{10°C}$, $GSE_{10°C}$ (Days), and $LGS_{10°C}$ (Days) Trend Slope (points/10 years), Coefficient of Determination, R^2, and Statistical Significance of Changes, *p-value* for 1961-2014

Station	$GSS_{10°C}$	*Trend*	R^2	*p-value*	$GSE_{10°C}$	*Trend*	R^2	*p-value*	$LGS_{10°C}$	*Trend*	R^2	*p-value*
Briceni	19/04	-0.67	1	0.4043	11/10	-0.24	0.1	0.7905	175	0.43	0.2	0.7397
Soroca	17/04	-0.85	2	0.3253	14/10	-0.92	2	0.3602	180	-0.07	0.0	0.9516
Camenca	16/04	-0.71	1	0.4294	15/10	-0.34	0.2	0.7190	182	0.37	0.1	0.7882
Ribnita	15/04	-1.02	2	0.2785	16/10	0.99	2	0.3172	184	2.00	4	0.1715
Balti	15/04	-1.26	3	0.1913	16/10	-0.19	0.1	0.8402	184	1.07	1	0.4444
Falesti	14/04	-1.20	3	0.2384	19/10	1.87	6	**0.0741**	188	2.97	7	**0.0601**
Bravicea	13/04	-1.13	3	0.2484	18/10	1.74	6	**0.0833**	188	2.91	6	**0.0692**
Cornesti	15/04	-1.17	3	0.2499	19/10	1.74	5	**0.0985**	186	2.91	6	**0.0664**
Dubasari	12/04	-0.93	2	0.2910	20/10	2.22	9	**0.0254**	191	3.14	9	**0.0284**
Tiraspol	13/04	-1.00	2	0.2743	20/10	1.04	3	0.2420	190	1.44	2	0.2790
St-Voda	15/04	-0.50	0.5	0.6014	20/10	1.03	3	0.2386	188	1.53	2	0.2629
Baltata	13/04	-0.73	1	0.4279	18/10	0.68	1	0.4704	188	1.41	2	0.2945
Chisinau	13/04	-0.90	2	0.3453	19/10	0.99	2	0.2887	189	1.90	4	0.1585
Leova	14/04	-0.25	0.1	0.7911	21/10	0.32	0.2	0.7365	191	0.58	0.3	0.6969
Comrat	13/04	-0.89	2	0.3294	21/10	1.46	5	**0.0996**	192	2.34	6	**0.0853**
Cahul	13/04	-0.87	1	0.3908	21/10	0.92	3	0.2520	191	1.79	3	0.1987

The length of growing season with average temperatures above *10°C*, $LGS_{10°C}$ has varied from 175 days in the North of the country (Briceni) to 191 days in the South (Cahul) on the average for 1961-2014 years. For comparison, for the 1961-1990 years the $LGS_{10°C}$ was from 172 days in the North (Briceni) up to 182 days in the South (Cahul) (Ţăranu, 2014). Additional information on the temporal and spatial development of $LGS_{10°C}$ throughout the RM is presented in **Table 5-18,** and **Figure 5-48**.

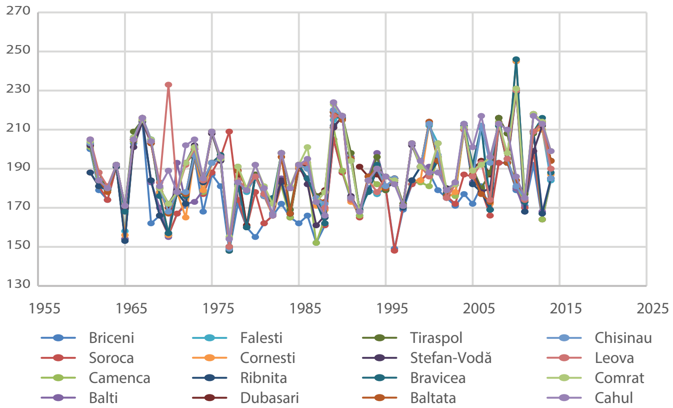


Figure 5-48: The Length of Growing Season, $LGS_{10°C}$ (Days), Development throughout the RM in 1961-2014 Time Period.

The increasing trend in the length of growing season with average temperatures above *10°C*, $LGS_{10°C}$, have been observed over territory of the RM. The *CLTS* values of the $LGS_{10°C}$ trends in 1961-2014-time period have had a positive sign and varied from +0.37 to +3.14 days/10 years, and were statistically significant, for Dubasari ($p \le 0.05$), and Balti, Falesti, Bravicea, Cornesti, and Comrat ($p \le 0.1$), R^2 was from 6% to 9%, which shows a trend to gradual increase in the $LGS_{10°C}$ in the region, **Table 5-18**.

The start of growing season with average temperatures above *15°C*, $GSS_{15°C}$ in the spring has varied from 17/05 in the North of the country (Briceni) to 10/05 in the South (Cahul), and the end of growing season with average temperatures above 15°C, $GSE_{15°C}$ date occurrence in the autumn from 15/09 to 28/09, respectively on the average for 1961-2014 years. For comparison, for the 1961-1990 years the $GSS_{15°C}$ and $GSE_{15°C}$ were from 15/05 and 14/09 in the North (Briceni) up to 09/05 and 26/09 in the South (Cahul) (Ţăranu, 2014). Additional information on the temporal and spatial development of $GSS_{15°C}$ and $GSE_{15°C}$ occurrence throughout the RM is presented in **Table 5-19**.

The start of growing season with average temperatures above *15°C*, ($GSS_{15°C}$) during the 1961-2014 has a decreasing trend over the RM. The *CLTS* values of the $GSS_{15°C}$ trends in 1961-2014-time period had a negative sign and varied from -0.74 to -2.03 days/10 years, however they were not statistically significant, except Falesti ($p \le 0.1$), which shows only a tendency towards early start of the growing season with average temperatures above *15°C*, $GSE_{15°C}$ over the RM. The opposite increasing trend was observed for the end of growing season with average temperatures above *15°C*, ($GSE_{15°C}$) in autumn during the 1961-2014 over territory of the RM. The *CLTS* values of the $GSE_{15°C}$ trends in 1961-2014-time period had a positive sign and varied from +0.55 to +1.44 days/10 years, and were statistically significant only for Ribnita and Tiraspol ($p \le 0.1$), R^2 was 5%, so a slight tendency can be noted towards a later end of the growing season with average temperatures above *15°C*, $GSE_{15°C}$ in autumn, **Table 5-19**.

Table 5-19: The $GSS_{15°C}$, $GSE_{15°C}$ (Dates), $LGS_{15°C}$ (Days), Trend Slope (Days /10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value* for 1961-2014

Station	$GSS_{15°C}$	Trend	R^2	p-value	$GSE_{15°C}$	Trend	R^2	p-value	$LGS_{15°C}$	Trend	R^2	p-value
Briceni	17/05	-1.45	3	0.2113	15/09	0.98	2	0.3295	121	2.43	4	0.1371
Soroca	14/05	-0.84	1	0.4518	18/09	0.77	1	0.4252	127	1.60	2	0.2859
Camenca	13/05	-1.26	2	0.2582	20/09	0.81	2	0.3687	130	2.07	4	0.1593
Ribnita	12/05	-1.38	3	0.1880	21/09	1.44	5	**0.0914**	132	2.81	8	**0.0325**
Balti	11/05	-1.66	5	0.1068	21/09	0.55	1	0.5323	133	2.21	6	**0.0853**
Falesti	10/05	-2.03	6	**0.0714**	24/09	1.06	2	0.2759	137	3.10	9	**0.0301**
Bravicea	11/05	-0.95	2	0.3643	21/09	1.11	3	0.1895	133	2.05	4	0.1258
Cornesti	12/05	-1.13	2	0.2948	22/09	0.80	1	0.4330	133	1.93	3	0.2257
Dubasari	9/05	-1.10	3	0.2379	26/09	1.34	5	0.1000	140	2.50	8	**0.0395**
Tiraspol	10/05	-0.82	2	0.3756	26/09	1.38	5	**0.0975**	138	1.42	3	0.2837
St-Voda	12/05	-1.10	3	0.1987	25/09	0.64	1	0.5057	136	1.74	4	0.1680
Baltata	11/05	-0.74	1	0.4903	24/09	0.57	1	0.5537	136	1.31	2	0.3848
Chisinau	11/05	-0.97	2	0.3312	25/09	0.95	2	0.2952	137	1.92	2	0.1625
Leova	10/05	-0.81	1	0.4017	26/09	1.03	2	0.2567	138	1.84	4	0.1410
Comrat	10/05	-0.75	1	0.4404	27/09	1.12	3	0.1902	140	1.87	4	0.1243
Cahul	10/05	-0.76	1	0.3917	28/09	0.91	2	0.2830	140	1.67	4	0.1695

The length of growing season with average temperatures above *15°C*, $LGS_{15°C}$ varied from 121 days in the North of the country (Briceni) to 140 days in the South (Cahul) on the average for 1961-2014 years. Additional information on the temporal and spatial development of $LGS_{15°C}$ throughout the RM is presented in **Table 5-19,** and **Figure 5-49**. The increasing trend in the length of growing season with average temperatures above *15°C*, $LGS_{15°C}$, was observed over territory of the RM. The *CLTS* values of the $LGS_{15°C}$ trends in 1961-2014-time period had a positive sign and varied from +1.32 to +3.10 days/10 years, and were statistically significant, for Falesti, Ribnita, Dubasari ($p \le 0.05$), and Balti ($p \le 0.1$), R^2 was from 6% to 9%, which shows a slight trend to gradual increase in the $LGS_{15°C}$ in the districts, **Table 5-19**.

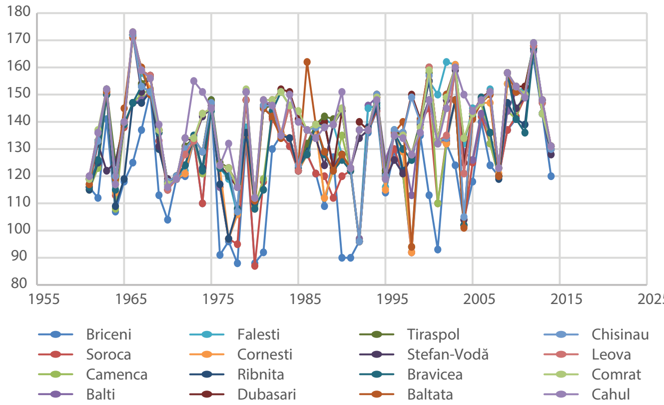


Figure 5-49: The Length of Growing Season, *LGS* $_{15°C}$ (Days), Development throughout the RM in 1961-2014 Time Period.

III. Growing Degree Days, AGDD$_{5,10,\ and\ 15°C}$ and EGDD$_{5,10,\ and\ 15°C}$

The $AGDD_{5°C}$ and $EGDD_{5°C}$ temperatures (lower limit for the grain crop development) have increased significantly on the territory of the RM. The $AGDD_{5°C}$ and $EGDD_{5°C}$ have varied from 3268 and/or 2154°C[178] in the North (Briceni) up to 3823 and/or 2611°C in the South (Cahul) on the average for 1961-2014 years. For comparison, according to Ţăranu, 2014, for the 1961-1990 years the $AGDD_{5°C}$ and $EGDD_{5°C}$ were from 3105 and/or 1995°C in the North (Briceni) up to 3652 and/or 2472°C in the South (Cahul). Additional information on the temporal and spatial development of $AGDD_{5°C}$ and $EGDD_{5°C}$ temperatures throughout the RM is presented in **Table 5-20**, **Figures 5-50 (A)**, and **5-51 (A)**.

The *CLTS* values of the active growing degree days with average temperatures above 5°C $AGDD_{5°C}$ trends in 1961-2014, throughout the territory of the RM, were statistically significant; they have had a positive sign and varied from +54.14 to +102.31°C/10 years, R^2 was from 11% to 30%, which shows an increase in the $AGDD_{5°C}$ in the region. The value of the coefficient of determination, R^2, of 20-38% was significantly higher for the effective growing degree days with average temperatures above 5°C $EGDD_{5°C}$ with a *CLTS* of +59.61°C/10 years to 83.89°C/10 years, which shows a higher statistical significance of the conclusions for changes towards increase of the $AGDD_{5°C}$ and $EGDD_{5°C}$ throughout the territory of the RM. The highest growth rate of the $AGDD_{5°C}$ and/or $EGDD_{5°C}$ was on the average for 1961-2014, from +82.91 and/or +80.38 to +102.31 and/or +89.40°C/10 years, which was observed in Briceni, Falesti, Cornesti, Dubasari, Chisinau, Comrat, Cahul and the lowest is being +54.14 and/or +59.61°C/10 years in Stefan-Voda, **Table 5-20.**

[178] Here and throughout the text the first pair of numbers corresponds to AGDD $_{5°C}$, and the second one EGDD $_{5°C}$

Table 5-20: The $AGDD_{5°C}$ and $EGDD_{5°C}$, (°C), Trend Slope (°C/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, p-value for 1961-2014

Station	$AGDD_{5°C}$	*Trend*	R^2	*p-value*	$EGDD_{5°C}$	*Trend*	R^2	*p-value*
Briceni	3268	87.27	27	**0.0000**	2154	80.38	33	**0.0000**
Soroca	3407	80.68	22	**0.0003**	2285	75.03	28	**0.0000**
Camenca	3526	75.91	19	**0.0009**	2366	66.68	24	**0.0001**
Ribnita	3560	84.22	25	**0.0001**	2409	79.33	31	**0.0000**
Balti	3583	80.91	25	**0.0001**	2392	70.62	29	**0.0000**
Falesti	3682	102.31	30	**0.0000**	2505	97.07	38	**0.0000**
Bravicea	3647	79.85	22	**0.0003**	2472	79.23	30	**0.0000**
Cornesti	3569	96.01	27	**0.0000**	2400	89.40	34	**0.0000**
Dubasari	3798	92.47	28	**0.0000**	26.06	85.94	32	**0.0000**
Tiraspol	3795	72.32	19	**0.0009**	2595	73.21	27	**0.0000**
St-Voda	3704	54.14	11	**0.0127**	2528	59.61	20	**0.0006**
Baltata	3668	70.19	19	**0.0013**	2487	64.76	23	**0.0003**
Chisinau	3758	91.87	26	**0.0000**	2572	82.79	32	**0.0000**
Leova	3745	72.82	29	**0.0007**	2547	73.90	28	**0.0000**
Comrat	3819	86.09	25	**0.0001**	2614	83.17	34	**0.0000**
Cahul	3823	82.91	20	**0.0008**	2611	83.89	32	**0.0000**

For the majority of the cultivated plant species in the RM the biologically active air temperature means the $AGDD_{10°C}$ and/or $EGDD_{10°C}$. The $AGDD_{10°C}$ and/or $EGDD_{10°C}$ temperatures have increased significantly on the territory of the RM. The $AGDD_{10°C}$ and/or $EGDD_{10°C}$ have varied from 2888 and/or 1165°C[179] in the North (Briceni) up to 3444 and/or 1527°C in the South (Cahul) on the average for 1961-2014 years. For comparison, according to Ţăranu, 2014, for the 1961-1990 years the $AGDD_{10°C}$ and $EGDD_{10°C}$ were from 2745 and/or 1025°C in the North (Briceni) up to 3222 and/or 1402°C in the South (Cahul). Additional information on the temporal and spatial development of $AGDD_{10°C}$ and $EGDD_{10°C}$ temperatures throughout the RM is presented in **Table 5-21**, **Figures 5-50 (B)**, and **5-51 (B)**.

The *CLTS* values of the active growing degree days with average temperatures above 10°C, $AGDD_{10°C}$ trends in 1961-2014, throughout the territory of the RM, were statistically significant; they have had a positive sign and varied from +52.35 to +96.29°C/10 years, R^2 was from 10% to 25%, which shows an increase in the $AGDD_{10°C}$ in the region. The value of the coefficient of determination, R^2, of 17-33% was higher for the effective growing degree days with average temperatures above 10°C, $EGDD_{10°C}$ with a *CLTS* of +43.09°C/10 years to 74.20°C/10 years, which shows a higher statistical significance of the conclusions for changes towards increasing of the $AGDD_{10°C}$ and $EGDD_{10°C}$ throughout the territory of the RM. The highest growth rate of the $AGDD_{10°C}$ and $EGDD_{10°C}$ was on the average for 1961-2014, from +79.22 and/or +62.29 to +96.29 and/or 74.20°C/10 years, which was observed in Falesti, Bravicea, Cornesti, Dubasari, Chisinau, Comrat, Cahul and the lowest is being +52.35 and/or 43.09°C/10 years in Stefan-Voda, **Table 5-21.**

[179] Here and throughout the text the first pair of numbers corresponds to $AGDD_{10°C}$, and the second one $EGDD_{10°C}$

Table 5-21: The $AGDD_{10°C}$ and $EGDD_{10°C}$, (°C), Trend Slope (°C/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value* for 1961-2014

Station	$AGDD_{10°C}$	*Trend*	R^2	*p-value*	$EGDD_{10°C}$	*Trend*	R^2	*p-value*
Briceni	2888	62.80	15	**0.0041**	1165	56.61	26	**0.0000**
Soroca	3037	55.66	12	**0.0099**	1275	54.30	22	**0.0003**
Camenca	3157	53.55	10	**0.0195**	1346	5091	23	**0.0002**
Ribnita	3204	73.51	18	**0.0012**	1375	59.05	25	**0.0000**
Balti	3208	61.45	15	**0.0043**	1356	49.03	21	**0.0004**
Falesti	3315	96.29	25	**0.0000**	1449	74.20	33	**0.0000**
Bravicea	3270	81.78	20	**0.0008**	1409	57.65	26	**0.0000**
Cornesti	3201	90.41	23	**0.0002**	1358	70.72	31	**0.0000**
Dubasari	3438	89.79	24	**0.0002**	1534	62.29	27	**0.0000**
Tiraspol	3429	73.89	18	**0.0015**	1523	57.29	24	**0.0000**
St-Voda	3337	52.35	10	**0.0173**	1468	43.09	17	**0.0019**
Baltata	3301	59.63	13	**0.0065**	1429	44.12	17	**0.0021**
Chisinau	3397	83.66	22	**0.0003**	1510	63.16	27	**0.0000**
Leova	3365	63.95	15	**0.0041**	1480	56.05	26	**0.0000**
Comrat	3453	79.22	21	**0.0005**	1537	66.36	33	**0.0000**
Cahul	3444	82.24	19	**0.0009**	1527	65.71	29	**0.0000**

The $AGDD_{15°C}$ and/or $EGDD_{15°C}$ temperatures have increased significantly on the territory of the RM. The $AGD_{15°C}$ and/or $EGDD_{15°C}$ have varied from 2209 and/or 442°C[180] in the North (Briceni) up to 2789 and/or 712°C in the South (Cahul) on the average for 1961-2014 years. Additional information on the temporal and spatial development of $AGDD_{15°C}$ and $EGDD_{15°C}$ temperatures throughout the RM is presented in **Table 5-22**, **Figures 5-50 (C)** and **5-51 (C)**.

The *CLTS* values of the active growing degree days with average temperatures above *15°C*, $AGDD_{15°C}$ trends in 1961-2014, throughout the territory of the RM, were statistically significant; they have had a positive sign and varied from +50.93 to +101.09°C/10 years, R^2 was from 6% to 20%, which shows a gradual increase in the $AGDD_{15°C}$ in the region. The value of the coefficient of determination, R^2, of 18-34% was higher for the effective growing degree days with average temperatures above *15°C*, $EGDD_{15°C}$ with a *CLTS* of +35.49°C/10 years to 58.02 °C/10 years, which shows the statistical significance of the conclusions for changes towards increase of the $AGDD_{15°C}$ and $EGDD_{15°C}$ throughout the territory of the RM.

The highest growth rate of the $AGDD_{15°C}$ and $EGDD_{15°C}$ was on the average for 1961-2014, from +81.23 and/or +50.67[181] to +101.09 and/or 58.02 °C/10 years, which was observed in Falesti, Ribnita, Cornesti, Dubasari, Tiraspol, Chisinau, Comrat, and the lowest being +50.93 and/or 35.49 °C/10 years in Stefan-Voda, **Table 5-22.**

[180] Here and throughout the text the first pair of numbers corresponds to $AGDD_{15°C}$, and the second one $EGDD_{15°C}$

[181] Here and throughout the text the first pair of numbers corresponds to $AGDD_{15°C}$, and the second one $EGDD_{15°C}$

Table 5-22: The $AGDD_{15°C}$ and $EGDD_{15°C}$, (°C), Trend Slope (°C/10 years), Coefficient of Determination, R^2, and Statistical Significance of Changes, *p-value* for 1961-2014

Station	$AGDD_{15°C}$	*Trend*	R^2	*p-value*	$EGDD_{15°C}$	*Trend*	R^2	*p-value*
Briceni	2209	84.98	12	**0.0091**	442	41.94	31	**0.0000**
Soroca	2379	72.45	10	**0.0210**	527	44.10	25	**0.0001**
Camenca	2503	69.91	10	**0.0196**	576	46.22	32	**0.0000**
Ribnita	2545	88.81	17	**0.0019**	601	50.67	30	**0.0000**
Balti	2564	82.76	18	**0.0016**	582	41.72	26	**0.0000**
Falesti	2652	101.09	19	**0.0009**	652	58.02	34	**0.0000**
Bravicea	2585	75.80	13	**0.0063**	619	48.49	30	**0.0000**
Cornesti	2539	87.58	14	**0.0057**	584	53.65	31	**0.0000**
Dubasari	2799	92.43	20	**0.0008**	722	55.14	31	**0.0000**
Tiraspol	2774	82.78	18	**0.0016**	717	51.36	28	**0.0000**
St -Voda	2704	50.93	6	**0.0669**	679	35.49	18	**0.0011**
Baltata	2622	52.76	6	**0.0849**	641	37.38	19	**0.0000**
Chisinau	2734	81.23	15	**0.0044**	701	51.96	30	**0.0000**
Leova	2709	73.03	13	**0.0081**	678	47.03	27	**0.0000**
Comrat	2802	86.48	18	**0.0013**	729	54.98	32	**0.0000**
Cahul	2789	76.99	15	**0.0037**	712	53.51	31	**0.0000**

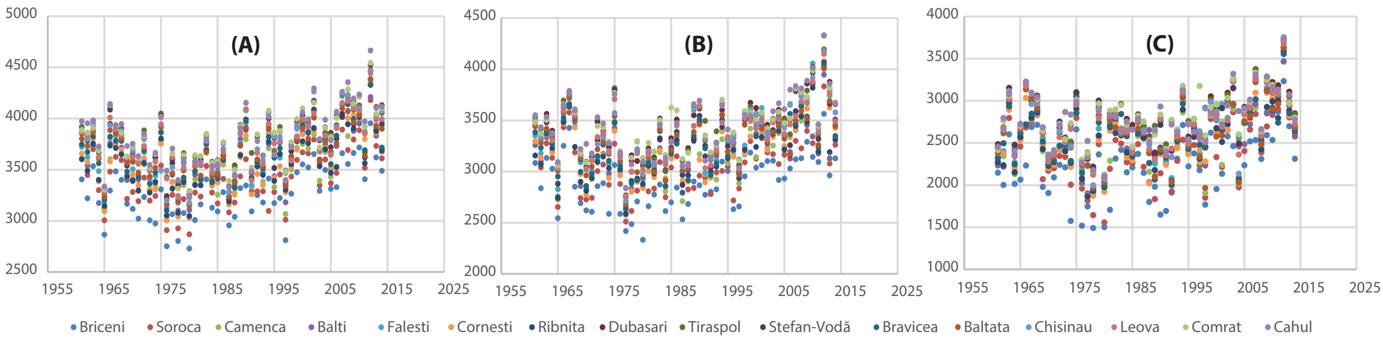


Figure 5-50: The Active Growing Degree Days, $AGDD_{5°C,\ 10°C,\ and\ 15°C}$ with Accumulated Sum of Temperature Degrees above 5°C, 10°C and 15°C in 1961-2014: (A) $AGDD_{5°C}$; (B) $AGDD_{10°C}$; (C) $AGDD_{15°C}$.

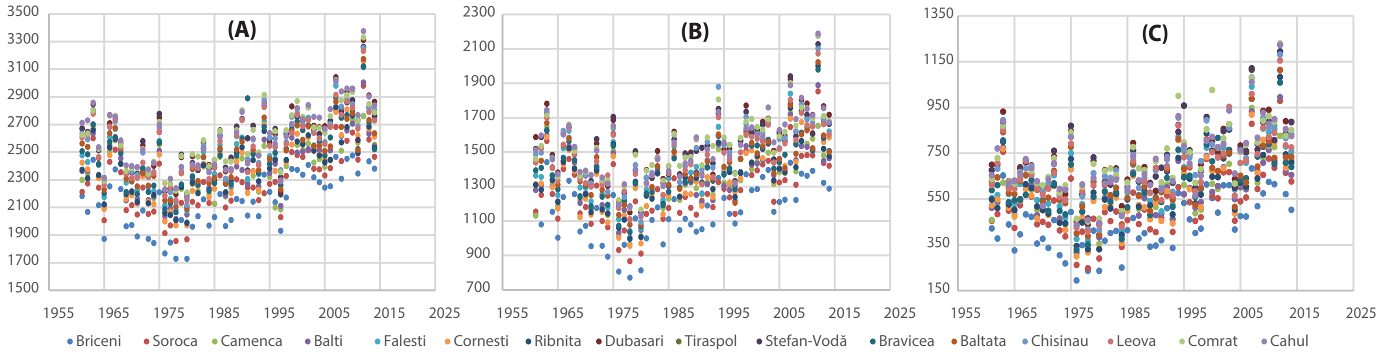


Figure 5-51: The Effective Growing Degree Days, *EGDD*$_{5°C,\ 10°C,\ and\ 15°C}$ with Accumulated Sum of Temperature Degrees above 5°C, 10°C and 15°C Minus T$_{base}$ in 1961-2014: (A) *EGDD*$_{5°C}$; (B) *EGDD*$_{10°C}$; (C) *EGDD*$_{15°C}$.

5.3.1.3. Projections of Future Changes in Thermal Agroclimatic Indices throughout the RM´s AEZs in XXI Century According to the CMIP5 Ensemble of 21 GCMs

For evaluating the thermal heat resources active and effective temperatures above 0°C, 5°C, 10°C and 15°C for baseline climate (1986-2005) as well as projections of possible changes from the baseline climate (°C), for three future time periods 2016-2035, 2046-2065 and 2081-2100, according to ensembles of 21 GCMs for three Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6 in Northern, Central and Southern AEZs were calculated.

I. Projections of Future Changes in Frost Indices

In the future RM's climate due to the earlier onset of spring and longer autumn, a substantial increase in the duration of the warm period can be expected.

The duration of the warm period with temperatures above 0°C for baseline climate varies from 272 days in the north of the country to 286 days in the south. Because of climate change by the 2016-2035, the duration of the warm period may increase from 3 days (RCP2.6) to 10 days (RCP8.5) in Northern and from 9 days (RCP2.6) to 20 days (RCP8.5) in Southern AEZs, **Table 5-23**.

Table 5-23: Projected CMIP5 21 GCMs Ensemble Changes of the LSF $_{0°C}$, FFD $_{0°C}$, (Dates) and FFP, (Days), under Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986–2005 Climatological Baseline Period in XXI Century

AEZ	RCP8.5			RCP4.5			RCP2.6		
	LSF $_{0°C}$	FFD $_{0°C}$	FFP (+/-)	LSF $_{0°C}$	FFD $_{0°C}$	FFP (+/-)	LSF $_{0°C}$	FFD $_{0°C}$	FFP (+/-)
2016–2035									
Northern	23/02	30/11	**+10**	01/03	30/11	**+3**	07/03	06/12	**+3**
Central	17/02	07/12	**+11**	17/02	30/11	**+4**	19/02	07/12	**+9**
Southern	06/02	07/12	**+20**	06/02	07/12	**+20**	17/02	07/12	**+9**
2046–2065									
Northern	06/02	16/12	**+43**	23/02	07/12	**+17**	23/02	30/11	**+10**
Central	06/02	16/12	**+31**	06/02	07/12	**+22**	17/02	16/12	**+20**
Southern	05/02	22/12	**+36**	06/02	08/12	**+21**	17/02	16/12	**18**
2081-2100									
Northern	-	-	-	08/02	07/12	**+32**	23/02	05/12	**+15**
Central	-	-	-	06/02	22/12	**+37**	06/12	16/12	**+31**
Southern	-	-	-	06/02	22/12	**+35**	06/12	16/12	**+29**

Note: *The observed mean for baseline period 1986-2005: the date when average daily air temperature is above 0°C (spring) - Briceni (03/03); Chisinau (21/02); Cahul (19/02). The date when average daily air temperature is above 0°C (autumn) - Briceni (22/11); Chisinau (30/11); Cahul (30/11); length of the period with the average daily air temperature above 0°C, days - Briceni (272); Chisinau (284); Cahul (286).*

By the end of the century, the duration of the period with temperatures above 0°C in the Central and Southern AEZs will increase significantly from 29-31 days (RCP2.6) to 35-37 days (RCP4.5). The lowest growth is expected in the Northern AEZ from 15 to 32 days.

II. Projections of Future Changes in the Length of Growing Season, LGS$_{5,\ 10,\ and\ 15°C}$

The growing season with temperatures above 5°C for baseline climate varies from 221 days in the north of the country up to 232 days in the south. Analysis of the data presented in the **Table 5-24** shows that the growing season with temperatures above 5°C will extend, and its increase in the 2016-2035 can be by 9-10 days according all Representative Concentration Pathways RCPs for Northern and 14-15 days for Southern AEZs. In the central region less increase is expected in the duration of the growing season from 1 day (RCP2.6) to 6 days (RCP8.5).

By the end of the 21th century the length of the period with the average daily temperatures above 5°C will increase substantially from 15 (RCP2.6) to 49-52 (RCP8.5) days in Central and Southern regions. In Northern AEZ the lowest growth in the duration of the growing season is expected with the average daily temperatures above 5°C from 9 days (RCP2.6) to 40 days (RCP8.5) relative to the 1986-2005 baseline time period. For all AEZs by the end of the century the growing season with temperatures above 5°C will increase, mainly due to earlier start the spring vegetation (from 5 to 22[182] days in Northern; 6 to 29 days in Central; and 10 to 31 days before in Southern AEZs), while the autumn will finish later than usual from 4 to 18 days in Northern; from 9 to 20 days in Central; and from 9 to 21 days in Southern AEZs by the 2081-2100 in comparison to the 1986-2005 reference time period, **Table 5-24**.

[182] Here and throughout the text the first number corresponds to the RCP2.6 scenario, the second to RCP8.5 scenario.

Table 5-24: Projected CMIP5 21 GCMs Ensemble Changes of the $GSS_{5°C,}$ $GSE_{5°C,}$ (Dates) and $LGS_{5°C,}$ (Days), under Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986-2005 Climatological Baseline Period in XXI Century

AEZ	RCP8.5			RCP4.5			RCP2.6		
	$GSS_{5°C}$	$GSE_{5°C}$	(+/-)	$GSS_{5°C}$	$GSE_{5°C}$	(+/-)	$GSS_{5°C}$	$GSE_{5°C}$	(+/-)
2016–2035									
Northern	24/03	09/11	**+10**	24/03	08/11	**+9**	24/03	08/11	**+9**
Central	17/03	09/11	**+6**	18/03	09/11	**+5**	22/03	09/11	**+1**
Southern	17/03	18/11	**+15**	18/03	18/11	**+14**	18/03	18/11	**+14**
2046–2065									
Northern	18/03	18/11	**+25**	23/03	09/11	**+11**	23/03	09/11	**+11**
Central	13/03	22/11	**+23**	16/03	19/11	**+17**	17/03	18/11	**+15**
Southern	13/03	22/11	**+23**	14/03	19/11	**+19**	17/03	18/11	**+15**
2081-2100									
Northern	07/03	22/11	**+40**	20/03	09/11	**+14**	24/03	08/11	**+9**
Central	23/02	29/11	**+49**	14/03	20/11	**+20**	17/03	18/11	**+15**
Southern	21/02	30/11	**+52**	13/03	18/11	**+21**	17/03	18/11	**+15**

Note. *The observed mean for 1986–2005 period: the date when the $T_{avg>5°C}$ (spring) - Briceni (29/03); Chisinau (23/03); Cahul (23/03). The date when the $T_{avg>5°C}$ (autumn) - Briceni (04/11); Chisinau (09/11); Cahul (09/11); length of the period with the $T_{avg>5°C}$, days - Briceni (221); Chisinau (232); Cahul (232).*

The growing season with temperatures above 10ºC for the baseline climate varies from 170 days in Northern up to 185 days in the Southern areas of the country. In connection to climate change, it is expected that the growing season with temperatures above 10ºC will increase by 16 days according all RCP scenarios for Northern and from 3 to 19 days for Southern AEZs, respectively. In the Central region the lowest growth in the duration of the growing season is expected, from 2 days (RCP2.6) to 14 days (RCP8.5) by the 2016-2035 period, **Table 5-25**.

By the end of century, the length of the growing season with temperatures above 10ºC will increase substantially from 16-19 to 43-47 days in Northern and Southern AEZs. The tendency to minimum increase of the growing season with temperatures above 10ºC in the Central areas will persist, and by the 2081-2100 period, it would be expected that such periods will last from 15 to 40 days longer as compared to the 1986-2005 baseline period.

Table 5-25: Projected CMIP5 21 GCMs Ensemble Changes of the $GSS_{10°C,}$ $GSE_{10°C,}$ (Dates) and $LGS_{10°C,}$ (Days), under Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986-2005 Climatological Baseline Period in XXI Century

AEZ	RCP8.5			RCP4.5			RCP2.6		
	$GSS_{10°C}$	$GSE_{10°C}$	(+/-)	$GSS_{10°C}$	$GSE_{10°C}$	(+/-)	$GSS_{10°C}$	$GSE_{10°C}$	(+/-)
2016–2035									
Northern	16/04	18/11	**+16**	16/04	18/11	**+16**	16/04	18/11	**+16**
Central	04/04	20/11	**+14**	04/04	20/11	**+14**	16/04	20/11	**+2**
Southern	04/04	24/11	**+19**	04/04	20/11	**+15**	16/04	20/11	**+3**
2046–2065									
Northern	03/04	20/10	**+31**	16/04	18/10	**+16**	16/04	18/10	**+16**
Central	01/04	27/10	**+24**	03/04	24/10	**+19**	03/04	20/10	**+15**
Southern	02/04	27/10	**+24**	03/04	24/11	**+20**	04/04	24/11	**+19**
2081-2100									
Northern	31/03	02/11	**+47**	03/04	20/10	**+31**	16/04	18/10	**+16**
Central	25/03	05/11	**+40**	01/04	26/10	**+23**	03/04	20/10	**+15**
Southern	25/03	07/11	**+43**	02/04	27/10	**+24**	04/04	24/10	**+19**

Note: *The observed mean for 1986–2005 period: the date when $T_{avg>10°C}$ (spring) - Briceni (25/04); Chisinau (16/04); Cahul (17/04); the date when $T_{avg>10°C}$ (autumn) - Briceni (11/10); Chisinau (18/10); Cahul (18/10); length of the period with the $T_{avg>10°C}$, days - Briceni (170); Chisinau (186); Cahul (185).*

The growing season with temperatures above 15ºC for baseline climate varies from 117 days in the north of the country up to 142 days in the south. Analysis of the data presented in the **Table 5-26** shows that the growing season with temperatures above 15ºC will extend, and its increase in the 2016-2035 can amount to 14-15 days according all RCP scenarios for Northern and 6-11 days for Southern AEZs respectively. In the central region less increase is expected in the duration of the growing season from 1 day (RCP2.6) to 12 days (RCP8.5 and RCP4.5).

Table 5-26: Projected CMIP5 21 GCMs Ensemble Changes of the $GSS_{15°C,}$ $GSE_{15°C,}$ (Dates) and $LGS_{15°C,}$ (Days), under Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986–2005 Climatological Baseline Period in XXI Century

AEZ	RCP8.5			RCP4.5			RCP2.6		
	$GSS_{15°C}$	$GSE_{15°C}$	(+/-)	$GSS_{15°C}$	$GSE_{15°C}$	(+/-)	$GSS_{15°C}$	$GSE_{15°C}$	(+/-)
2016–2035									
Northern	09/05	17/09	**+15**	09/05	17/09	**+15**	10/05	17/09	**+14**
Central	30/04	30/09	**+12**	30/04	30/09	**+12**	10/05	29/09	**+1**
Southern	01/05	30/09	**+11**	01/05	29/09	**+10**	05/05	29/09	**+6**
2046–2065									
Northern	30/04	30/09	**+37**	30/04	24/09	**+31**	30/04	17/09	**+24**
Central	27/04	10/10	**+25**	30/04	04/10	**+16**	30/04	30/09	**+12**
Southern	27/04	10/10	**+25**	30/04	04/10	**+16**	30/04	04/10	**+16**
2081-2100									
Northern	26/04	10/10	**+51**	30/04	29/09	**+36**	30/04	17/09	**+24**
Central	18/04	18/10	**+42**	29/04	08/10	**+21**	30/04	30/09	**+12**
Southern	25/04	18/10	**+35**	30/04	09/10	**+21**	30/04	30/09	**+12**

Note: *The observed mean for 1986–2005 period: the date when $T_{avg>15°C}$ (spring) - Briceni (12/05); Chisinau (06/05); Cahul (09/05). The date when $T_{avg>15°C}$ (autumn) - Briceni (05/09); Chisinau (24/09); Cahul (27/09); length of the period with the $T_{avg>15°C}$, days - Briceni (117); Chisinau (142); Cahul (142).*

By the end of the 21th century the length of the period with the average daily temperatures above 15°C will increase substantially from 12 (RCP2.6) to 35-42 (RCP8.5) days in Central and Southern regions. In Northern AEZ the highest growth in the duration of the growing season is expected with average daily temperatures above 15°C from 24 days (RCP2.6) to 51 days (RCP8.5) as compared to the 1986-2005 baseline time period.

III. Projections of Future Changes in the Growing Degree Days, ADDD $_{5,\ 10,\ and\ 15\ °C}$ and EGDD $_{5,\ 10,\ and\ 15\ °C}$

The sum of active $\Sigma T_{ac > 5°C}$ and effective $\Sigma T_{ef > 5°}$ temperatures (lower limit of the grain crops development) will increase consistently on the territory of the RM. According to all three scenarios in the 2016-2035 period a small increase in the sum of active $\Sigma T_{ac > 5°C}$ and effective $\Sigma T_{ef > 5°}$ temperatures is expected, about 6-10% and 9-13%[183]. By 2081-2100 the sum of active $\Sigma T_{ac > 5°C}$ and effective $\Sigma T_{ef > 5°}$ temperatures would increase significantly under RCP8.5 by 42-43%, respectively by 50-57%, and will make from 4227 and 3322°C for Northern to 5245 and 3825°C for Southern AEZs. The lowest growth is expected according to RCP2.6 by 11% and respectively by 12-15%, varying from 3589 and 2433°C for Northern, to 4096 and 2861°C for Southern AEZs, relative to the 1986-2005 baseline climate, **Table 5-27**.

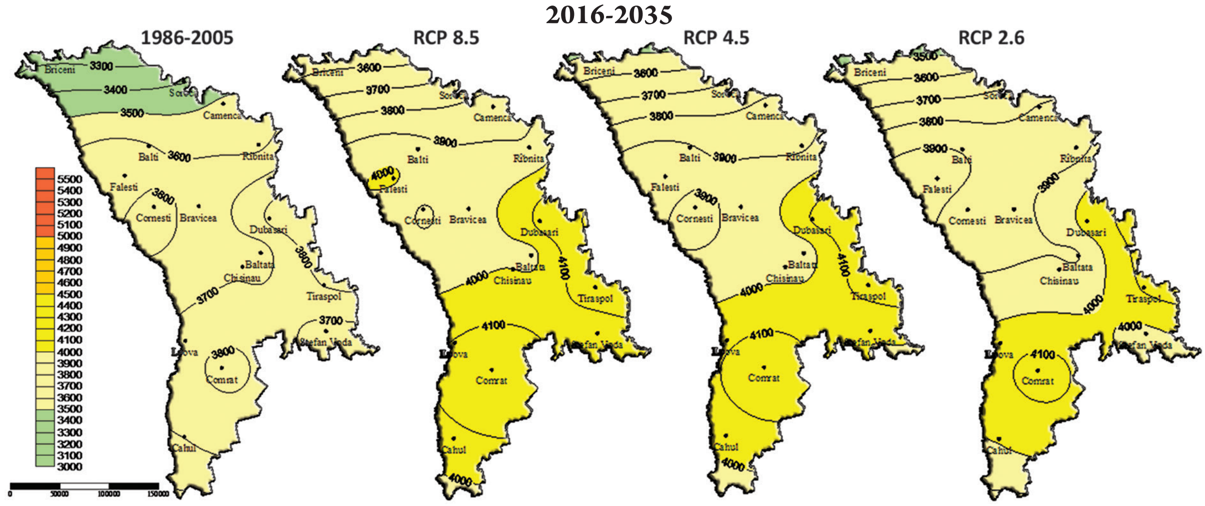
[183] Here and throughout the text the first pair of numbers corresponds to the $\Sigma T_{ac > 5°C}$, the second one $\Sigma T_{ef > 5°C}$

Table 5-27: Projected CMIP5 21 GCMs Ensemble Changes in the AGDD $_{5°C}$ and/or EGDD $_{5°C}$, °C, under Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986–2005 Climatological Baseline Period in XXI Century

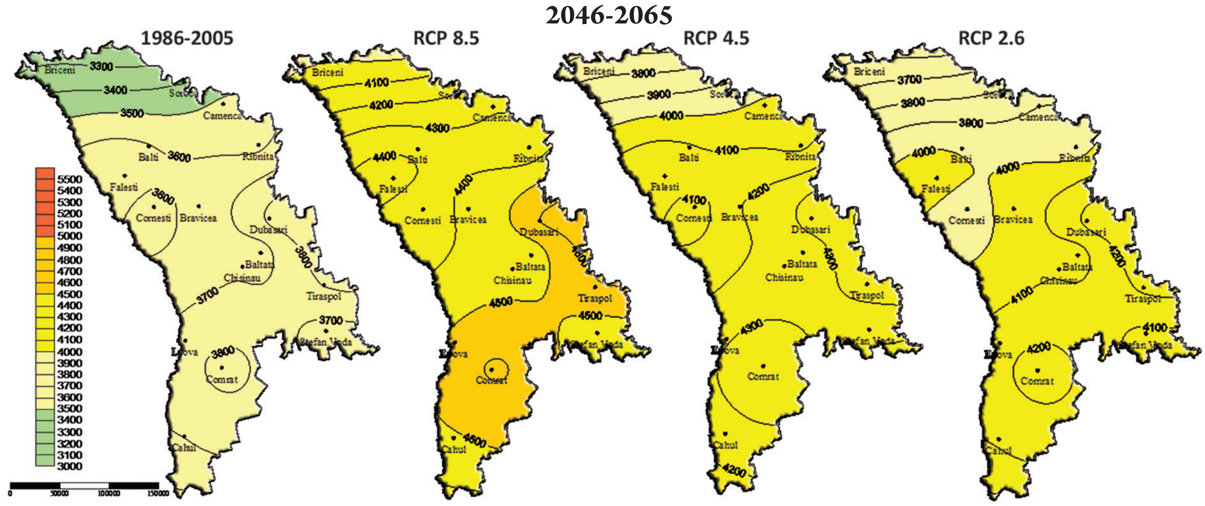
AEZ	RCP8.5				RCP4.5				RCP2.6			
	AGDD $_{5°C}$	%	EGDD $_{5°C}$	%	AGDD $_{5°C}$	%	EGDD $_{5°C}$	%	AGDD $_{5°C}$	%	EGDD $_{5°C}$	%
2016–2035												
Northern	3561	**10**	2406	**13**	3529	**9**	2379	**12**	3513	**9**	2363	**11**
Central	4001	**9**	2811	**11**	3980	**8**	2795	**11**	3917	**6**	2752	**9**
Southern	4070	**10**	2835	**12**	4044	**9**	2814	**11**	4010	**8**	2780	**9**
2046–2065												
Northern	3993	**24**	2763	**30**	3730	**16**	2570	**21**	3606	**12**	2446	**15**
Central	4470	**21**	3195	**26**	4229	**15**	2984	**18**	4091	**11**	2856	**13**
Southern	4487	**21**	3212	**26**	4253	**15**	2998	**18**	4114	**11**	2879	**13**
2081-2100												
Northern	4627	**43**	3322	**57**	3868	**20**	2693	**27**	3589	**11**	2433	**15**
Central	5207	**41**	3802	**50**	4382	**19**	3122	**24**	4078	**11**	2843	**12**
Southern	5245	**42**	3825	**50**	4406	**19**	3141	**24**	4096	**11**	2861	**12**

Note: *The observed mean annual sum of active and effective temperatures for reference period (1986–2005) were as following: ΣT_{ac} >5°C - Briceni* (3227°C); Chisinau (3688°C); *Cahul* (3703°C), and *$\Sigma T_{ef >5°C}$ - Briceni* (2122°C); Chisinau (2528°C); *Cahul* (2543°C).

2016-2035



2046-2065



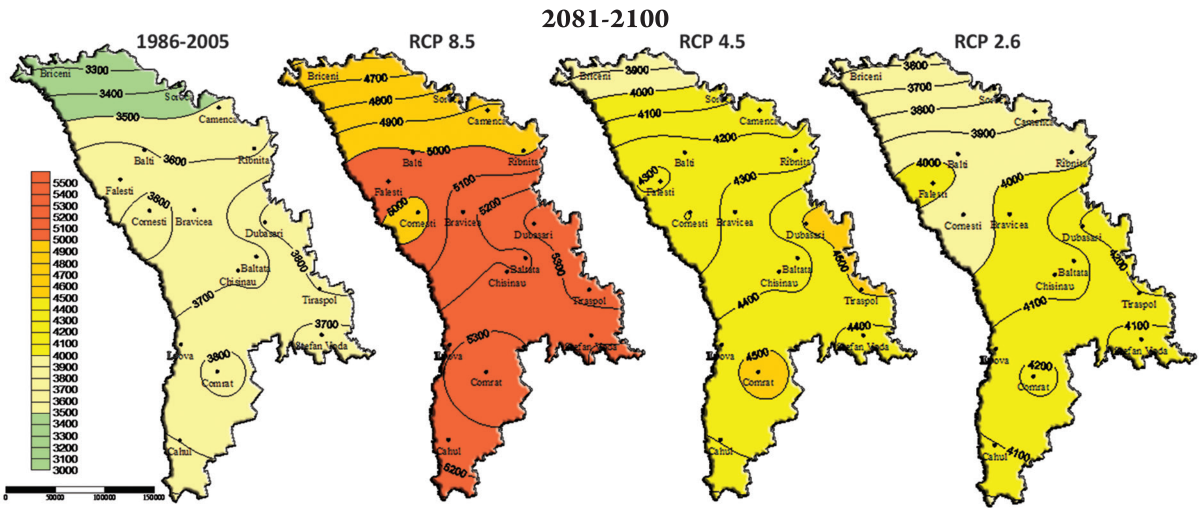


Figure 5-52: Projected CMIP5 21 GCMs Ensemble Sum of Active $\Sigma T_{ac>5°C}$ Temperature, °C, Development throughout the RM.

The **Figure 5-52**, shows the 21 multi-model ensemble estimate of spatial distribution of the RM's heat supply development (sum of active $\Sigma T_{ac>5°C}$) for three Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6 relative to the 1986-2005 baseline climate in the XXI century.

If in the baseline climate the growing degree days of active vegetation with $\Sigma T_{ac>5°C}$ varies across the territory from 3227 to 3825°C then by the 2016-2035 period these values will rise according to the high warming scenario RCP8.5 from 3561 to 4192°C and/or from 3513 to 4132°C under the low warming scenario RCP2.6. By the end of the century, these values could rise according to the high warming scenario RCP8.5 from 4627 to 5367°C and/or from 3589 to 4218°C under the low warming scenario RCP2.6.

For the majority of the cultivated plant species in the RM the biologically active air temperatures mean the sum of air temperatures values above 10°C. Already by 2016-2035 period the sum of biologically active and effective temperatures above 10°C will grow by 11-14 and 16-20%[184] under RCP8.5; and by 6-13 and 13-17% according to the RCP2.6 scenarios. By the end of century, the sum of active $\Sigma T_{ac>10°C}$ and effective $\Sigma T_{ef>10°}$ temperatures will increase essentially by 45-52 and 72-88% under the RCP8.5 scenario, and will make from 4316 and 2146°C for Northern to 4840 and 2560°C in Southern AEZs. The lowest growth is projected according to the RCP2.6 scenario by 12-15 and 17-22%, and will make from 3252 and 1392°C for Northern to 3787 and 1747°C in Southern AEZs relative to the 1986-2005 baseline climate, **Table 5-28**.

[184] Here and throughout the text the first pair of number corresponds to the $\Sigma T_{ac>10°C}$, the second one $\Sigma T_{ef>10°C}$

Table 5-28: Projected CMIP5 21 GCMs Ensemble Changes in the AGDD $_{10°C}$ and/or EGDD $_{10°C}$, under Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the Climatological Baseline Period in XXI Century

AEZ	RCP8.5				RCP4.5				RCP2.6			
	AGDD $_{10°C}$	%	EGDD $_{10°C}$	%	AGDD $_{10°C}$	%	EGDD $_{10°C}$	%	AGDD $_{10°C}$	%	EGDD $_{10°C}$	%
2016–2035												
Northern	3232	**14**	1372	**20**	3209	**13**	1349	**18**	3198	**13**	1338	**17**
Central	3713	**11**	1713	**16**	3702	**11**	1702	**15**	3546	**6**	1666	**13**
Southern	3768	**13**	1728	**16**	3711	**11**	1711	**15**	3565	**7**	1685	**13**
2046–2065												
Northern	3678	**29**	1668	**46**	3367	**19**	1507	**32**	3261	**15**	1401	**23**
Central	4137	**24**	2037	**38**	3909	**17**	1859	**26**	3760	**13**	1750	**18**
Southern	4136	**24**	2046	**37**	3915	**17**	1865	**25**	3804	**14**	1764	**18**
2081-2100												
Northern	4316	**52**	2146	**88**	3615	**27**	1605	**41**	3252	**15**	1392	**22**
Central	4810	**44**	2550	**72**	4063	**22**	1973	**33**	3749	**12**	1739	**17**
Southern	4840	**45**	2560	**72**	4073	**22**	1983	**33**	3787	**13**	1747	**17**

Note: *The observed mean annual sum of active and effective temperatures for reference period (1986–2005) were following* $\Sigma T_{ac>10°C}$ *- Briceni* (2840°C); Chisinau (3339°C); *Cahul* (3340°C); and $\Sigma T_{ef>10°C}$ *- Briceni* (1140°C); Chisinau (1479°C); *Cahul* (1490°C).

The **Figure 5-53**, show the CMIP5 21 GCMs ensemble estimation of spatial distribution of the RM's heat supply development (sum of active $\Sigma T_{ac>10°C}$) for three Representative Concentration Pathways, RCP8.5, RCP4.5 and RCP2.6 relative to the 1986-2005 baseline climate in the XXI century.

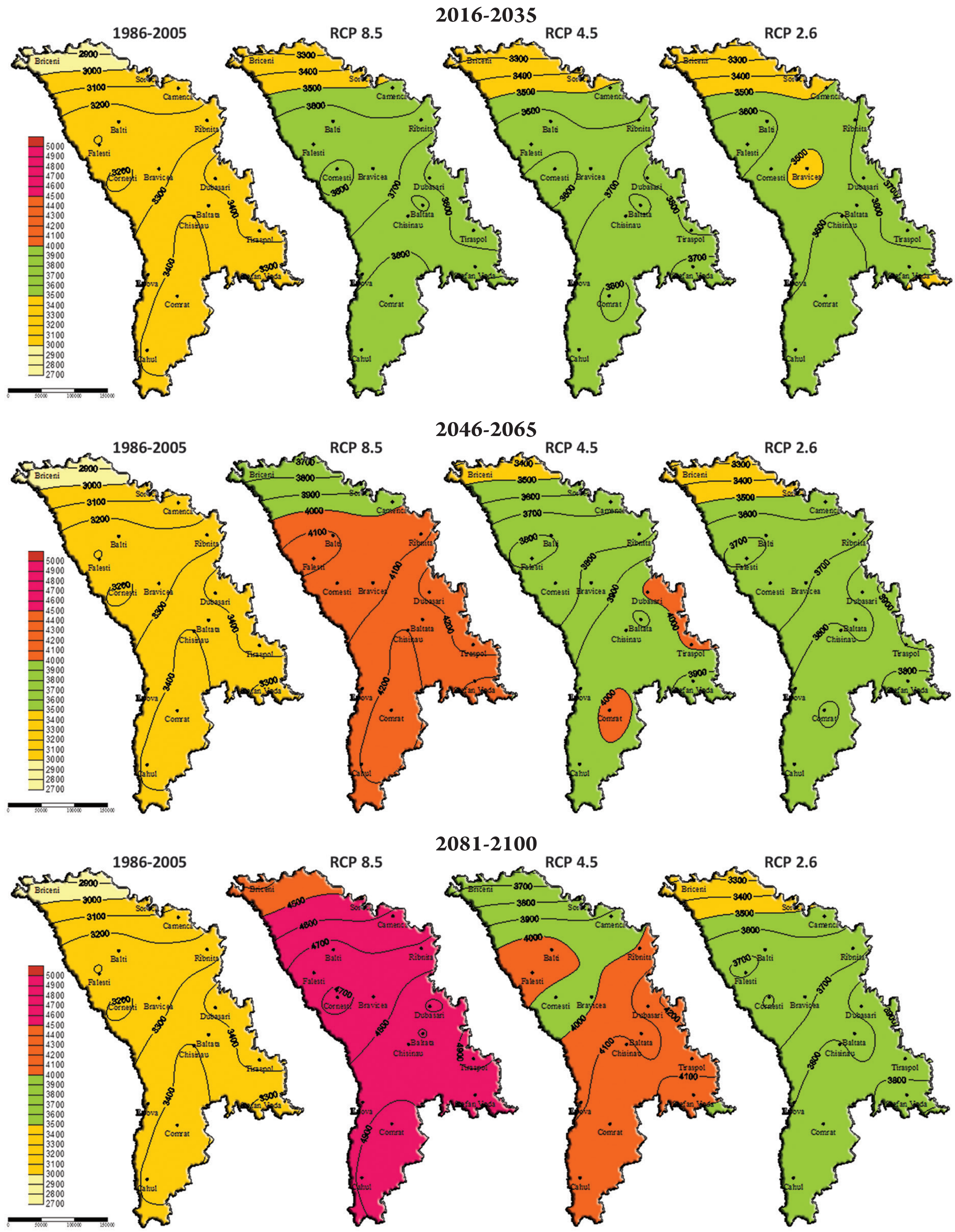


Figure 5-53: Projected CMIP5 21 GCMs Ensemble Sum of Active $\Sigma T_{ac>10°C}$ Temperature, °C Development throughout the RM.

If in the baseline climate the growing degree days of active vegetation with $\Sigma T_{ac>10°C}$ varies across the territory from 2895 to 3444°C then by the 2016-2035 period, these values will rise according to the high warming scenario RCP8.5 from 3287 to 3872°C and/or from 3257 to 3669°C under the low warming scenario RCP2.6. By the end of the century, these values could rise according to the high warming scenario RCP8.5 from 4371 to 4944°C and/or from 3307 to 3891°C under the low warming scenario RCP2.6.

The sum of active $\Sigma T_{ac>15°C}$ and effective $\Sigma T_{ef>15°}$ temperatures will increase consistently on the territory of the RM. According to all three scenarios in the 2016-2035 period a moderate increase in the sum of active $\Sigma T_{ac>15°C}$ and effective $\Sigma T_{ef>15°}$

temperatures is expected, about 12-18% and 29-43%[185] according to RCP8.5 and by 6-17% and 22-36% under RCP2.6 scenarios.

By the end of the century sum of active $\Sigma T_{ac>15°C}$ and effective $\Sigma T_{ef>15°}$ temperatures would increase significantly under RCP8.5 scenario by 50-73%, respectively by 132-202%, and will make from 3720 and 1200°C for Northern to 4201 and 1546°C for Southern AEZs. The lowest growth is expected according to RCP2.6 scenario by 14-25% and respectively by 31-45%, varying from 2691 and 576°C for Northern, to 3183 and 873°C for Southern AEZs, relative to the 1986-2005 baseline climate, **Table 5-29**.

[185] Here and throughout the text the first pair of numbers corresponds to the $\Sigma T_{ac>15°C}$, the second one $\Sigma T_{ef>15°C}$

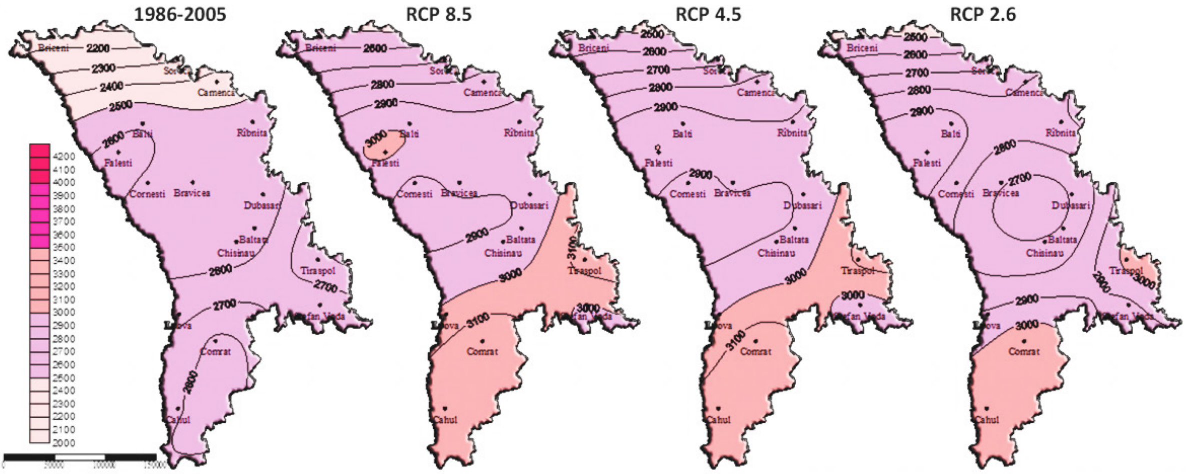
Table 5-29: Projected CMIP5 21 GCMs Ensemble Changes in the $AGDD_{15°C}$ and/or $EGDD_{15°C}$, under Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986–2005 Climatological Baseline Period in XXI Century

AEZ	RCP8.5				RCP4.5				RCP2.6			
	$AGDD_{15°C}$	%	$EGDD_{15°C}$	%	$AGDD_{15°C}$	%	$EGDD_{15°C}$	%	$AGDD_{15°C}$	%	$EGDD_{15°C}$	%
2016–2035												
Northern	2548	**18**	568	**43**	2530	**18**	550	**38**	2506	**17**	541	**36**
Central	3159	**13**	849	**29**	3150	**13**	840	**28**	2948	**6**	803	**22**
Southern	3158	**12**	863	**29**	3130	**12**	850	**27**	3045	**10**	825	**24**
2046–2065												
Northern	3114	**45**	804	**103**	2889	**34**	669	**68**	2697	**25**	582	**47**
Central	3615	**30**	1110	**69**	3333	**20**	963	**47**	3182	**14**	872	**33**
Southern	3624	**30**	1119	**68**	3340	**19**	970	**45**	3197	**14**	887	**33**
2081-2100												
Northern	3720	**73**	1200	**202**	3045	**42**	750	**89**	2691	**25**	576	**45**
Central	4295	**54**	1535	**134**	3497	**26**	1052	**60**	3175	**14**	865	**32**
Southern	4201	**50**	1546	**132**	3509	**25**	1064	**60**	3183	**14**	873	**31**

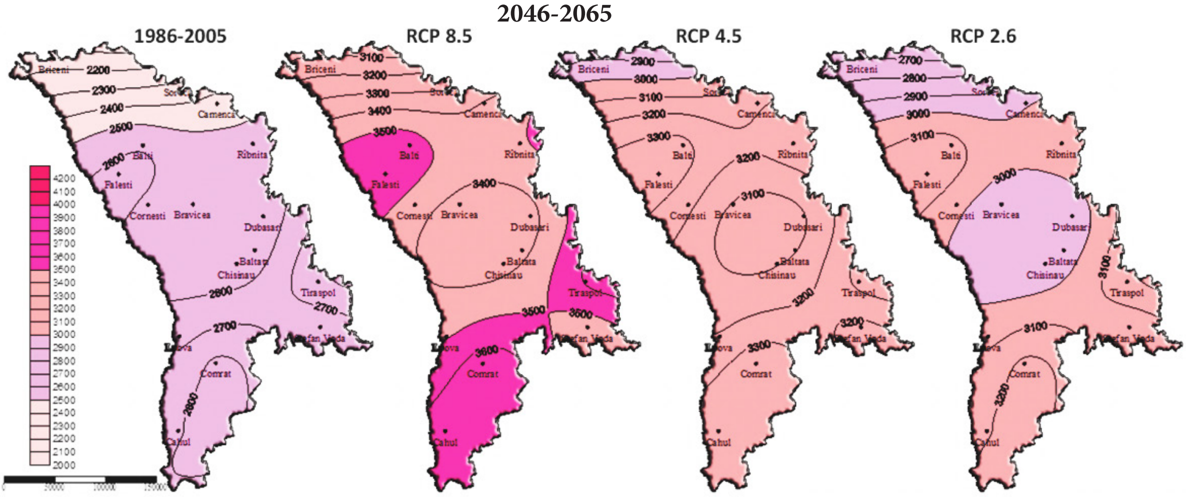
Note. *The observed mean annual sum of active and effective temperatures for reference period (1986–2005) were following:* $\Sigma T_{ac>15°C}$ *- Briceni* (2152°C); Chisinau (2786°C); *Cahul* (2797°C); $\Sigma T_{ef>15°C}$ *- Briceni* (397°C); Chisinau (656°C); *Cahul* (667°C).

Figure 5-54 shows the 21 multi-model ensemble estimation of spatial distribution of the RM's heat supply development (sum of active $\Sigma T_{ac>15°C}$) for three Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, relative to the 1986-2005 baseline climate in the XXI century.

2016-2035



2046-2065



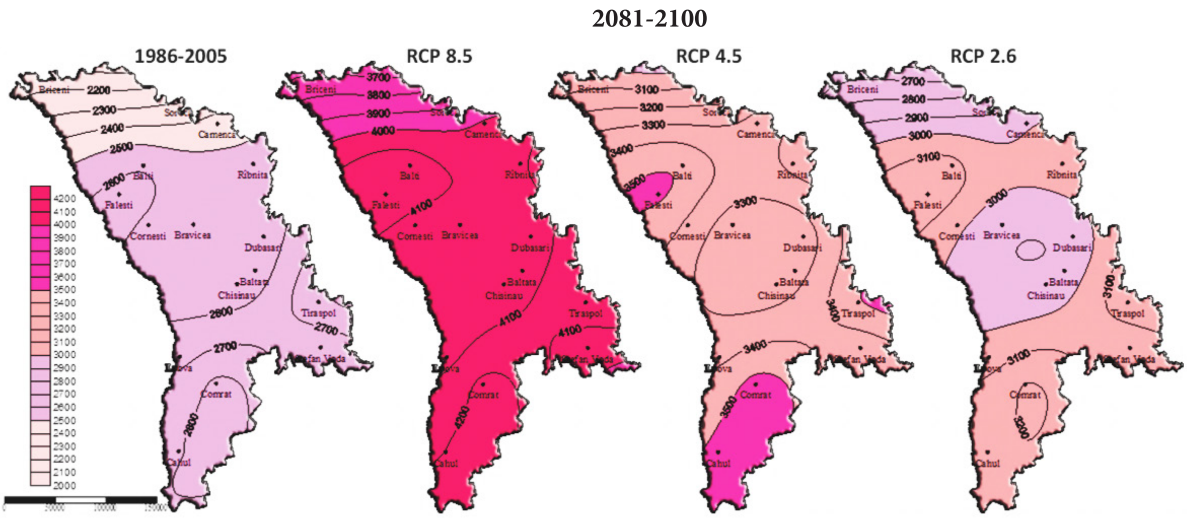


Figure 5-54: Projected CMIP5 21 GCMs Ensemble Sum of Active $\Sigma T_{ac>15°C}$ Temperature, °C Development throughout the RM.

If in the baseline climate the growing degree days of active vegetation with $\Sigma T_{ac>15°C}$ varies across the territory from 2152 to 2814°C, by the 2016-2035 period these values will rise according to the high warming scenario RCP8.5 from 2548 to 3175°C and/or from 2506 to 3062°C under the low warming scenario RCP2.6. By the end of the century, these values could rise according to the high warming scenario RCP8.5 from 3720 to 4218°C and/or from 2691 to 3200°C under the low warming scenario RCP2.6.

5.3.2. Climate Change and Humidity Resources

5.3.2.1. Data and Methods

In this study, humidity agroclimatic indices were calculated from daily climatic observed data for a baseline period (1986-2005), current climate (1961-2013) and for three future 20-yr time periods (2016–2035, 2046–2065, and 2081-2100) based on projections of changes in temperature received by regionalization of global experiments the most reliable in the RM CMIP5 21 GCMs for three Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6 (Taranu et al, 2015).

Regression equations of relationship of Potential Evaporation (*E*, mm) and Aridity Index (*AI*) with average monthly air temperature and precipitation for baseline period (1986-2005) is presented in the **Tables 5-30** and **5-31**.

Table 5-30: The Relationship of Potential Evaporation (*E, mm*) with Average Air Temperature (*T, °C*) and Precipitation (*P, mm*), 1986-2005

Month	*R-squared*	*P-value*	*Regression equation*
		Northern AEZ	
January	48.13	**0.0015**	$E_{Jan} = 19.44 + 1.06*T_{Jan} - 0.06*P_{Jan}$
February	86.03	**0.0000**	$E_{Feb} = 24.74 + 2.32*T_{Feb} - 0.02*P_{Feb}$
March	67.72	**0.0001**	$E_{Mar} = 23.45 + 4.36*T_{Mar} + 0.06*P_{Mar}$
April	56.00	**0.0009**	$E_{Apr} = 26.96 + 5.57*T_{Apr} - 0.23*P_{Apr}$
May	85.40	**0.0000**	$E_{May} = -3.69 + 8.62*T_{May} - 0.34*P_{May}$
June	59.65	**0.0004**	$E_{Jun} = -61.86 + 10.17*T_{Jun} - 0.22*P_{Jun}$
July	64.39	**0.0002**	$E_{Jul} = -85.31 + 10.20*T_{Jul} - 0.13*P_{Jul}$
August	52.84	**0.0017**	$E_{Aug} = -90.76 + 10.30*T_{Aug} - 0.08*P_{Aug}$
September	68.01	**0.0001**	$E_{Sep} = -16.26 + 6.76*P_{Sep} - 0.15*T_{Sep}$
October	39.51	**0.0139**	$E_{Oct} = 49.40 + 0.32*T_{Oct} - 0.17*P_{Oct}$
November	15.12	**0.2481**	$E_{Nov} = 21.07 + 0.45*T_{Nov} - 0.05*P_{Nov}$
December	60.86	**0.0003**	$E_{Dec} = 18.25 + 0.93*T_{Dec} - 0.07*P_{Dec}$
		Central AEZ	
January	63.34	**0.0002**	$E_{Jan} = 24.05 + 1.87*T_{Jan} - 0.13*P_{Jan}$
February	84.04	**0.0000**	$E_{Feb} = 30.04 + 3.40*T_{Feb} - 0.06*P_{Feb}$
March	73.83	**0.0000**	$E_{Mar} = 30.94 + 6.24*T_{Mar} - 0.23*P_{Mar}$
April	54.74	**0.0012**	$E_{Apr} = 43.92 + 4.86*T_{Apr} - 0.34*P_{Apr}$
May	89.83	**0.0000**	$E_{May} = 9.86 + 8.71*T_{May} - 0.49*P_{May}$
June	58.00	**0.0006**	$E_{Jun} = -94.72 + 12.44*T_{Jun} - 0.33*P_{Jun}$
July	68.22	**0.0001**	$E_{Jul} = -52.79 + 10.32*T_{Jul} - 0.34*P_{Jul}$
August	75.43	**0.0000**	$E_{Aug} = -199.03 + 16.74*T_{Aug} - 0.14*P_{Aug}$
September	75.82	**0.0000**	$E_{Sep} = -14.37 + 7.88*T_{Sep} - 0.21*P_{Sep}$
October	36.08	**0.0223**	$E_{Oct} = 66.67 + 0.01*T_{Oct} - 0.11*P_{Oct}$
November	7.05	**0.5269**	$E_{Nov} = 27.44 + 0.52*T_{Nov} - 0.06*P_{Nov}$
December	56.67	**0.0008**	$E_{Dec} = 24.45 + 1.51*T_{Dec} - 0.12*P_{Dec}$
		Southern AEZ	
January	55.65	**0.0010**	$E_{Jan} = 20.18 + 0.95*T_{Jan} - 0.19*P_{Jan}$
February	82.81	**0.0000**	$E_{Feb} = 26.20 + 3.28*T_{Feb} - 0.05*P_{Feb}$
March	79.10	**0.0000**	$E_{Mar} = 25.39 + 6.21*T_{Mar} - 0.21*P_{Mar}$
April	68.41	**0.0001**	$E_{Apr} = 46.39 + 4.01*T_{Apr} - 0.43*P_{Apr}$
May	82.89	**0.0000**	$E_{May} = -43.09 + 10.47*T_{May} - 0.27*P_{May}$
June	67.43	**0.0001**	$E_{Jun} = -174.99 + 15.83*T_{Jun} - 0.20*P_{Jun}$
July	44.80	**0.0064**	$E_{Jul} = -40.58 + 9.19*T_{Jul} - 0.24*P_{Jul}$
August	78.76	**0.0000**	$E_{Aug} = -179.96 + 15.71*T_{Aug} - 0.25*P_{Aug}$
September	70.41	**0.0000**	$E_{Sep} = -38.75 + 9.02*T_{Sep} - 0.19*P_{Sep}$
October	11.95	**0.3390**	$E_{Oct} = 41.43 + 1.86*T_{Oct} - 0.07*P_{Oct}$
November	28.63	**0.0569**	$E_{Nov} = 28.41 + 0.72*T_{Nov} - 0.16*P_{Nov}$
December	68.93	**0.0000**	$E_{Dec} = 20.55 + 1.37*T_{Dec} - 0.11*P_{Dec}$

Table 5-31: The Relationship of Aridity Index (*AI*) with Average Air Temperature (*T, °C*) and Precipitation (*P, mm*), 1986-2005

Month	*R-squared*	*P-value*	*Regression equation*
		Northern AEZ	
January	87.93	**0.0000**	$AI_{Jan} = -1.17 + 0.10*P_{Jan} - 0.31*T_{Jan}$
February	91.63	**0.0000**	$AI_{Feb} = -0.13 + 0.06*P_{Feb} - 0.22*T_{Feb}$
March	84.92	**0.0000**	$AI_{Mar} = 0.70 + 0.03*P_{Mar} - 0.18*T_{Mar}$
April	91.91	**0.0000**	$AI_{Apr} = 0.52 + 0.02*P_{Apr} - 0.06*T_{Apr}$
May	93.05	**0.0000**	$AI_{May} = 0.11 + 0.01*P_{May} - 0.02*T_{May}$
June	95.33	**0.0000**	$AI_{Jun} = 0.88 + 0.01*P_{Jun} - 0.07*T_{Jun}$
July	97.00	**0.0000**	$AI_{Jul} = 1.43 + 0.01*P_{Jul} - 0.07*T_{Jul}$
August	96.47	**0.0000**	$AI_{Aug} = 0.78 + 0.01*P_{Aug} - 0.04*T_{Aug}$
September	93.29	**0.0000**	$AI_{Sep} = 0.48 - 0.05*T_{Sep} + 0.02*P_{Sep}$
October	98.05	**0.0000**	$AI_{Oct} = -0.43 + 0.03*T_{Oct} + 0.03*P_{Oct}$
November	87.49	**0.0000**	$AI_{Nov} = 0.08 - 0.06*T_{Nov} + 0.05*P_{Nov}$
December	95.07	**0.0000**	$AI_{Dec} = -0.83 - 0.14*T_{Dec} + 0.09*P_{Dec}$

Month	*R-squared*	*P-value*	*Regression equation*
		Central AEZ	
January	93.74	**0.0000**	$AI_{Jan} = -0.67 - 0.15*T_{Jan} + 0.09*P_{Jan}$
February	88.88	**0.0000**	$AI_{Feb} = -0.02 - 0.16*T_{Feb} + 0.05*P_{Feb}$
March	88.49	**0.0000**	$AI_{Mar} = 0.19 - 0.11*T_{Mar} + 0.03*P_{Mar}$
April	89.62	**0.0000**	$AI_{Apr} = 0.17 - 0.02*T_{Apr} + 0.01*P_{Apr}$
May	91.75	**0.0000**	$AI_{May} = -0.01 - 0.01*T_{May} + 0.01*P_{May}$
June	94.11	**0.0000**	$AI_{Jun} = 1.21 - 0.06*T_{Jun} + 0.01*P_{Jun}$
July	96.23	**0.0000**	$AI_{Jul} = 0.70 - 0.03*T_{Jul} + 0.01*P_{Jul}$
August	94.50	**0.0000**	$AI_{Aug} = 0.98 - 0.04*T_{Aug} + 0.01*P_{Aug}$
September	94.23	**0.0000**	$AI_{Sep} = 0.34 - 0.03*T_{Sep} + 0.02*P_{Sep}$
October	99.17	**0.0000**	$AI_{Oct} = -0.18 - 0.01*T_{Oct} + 0.02*P_{Oct}$
November	79.08	**0.0000**	$AI_{Nov} = -0.09 - 0.01*T_{Nov} + 0.04*P_{Nov}$
December	89.37	**0.0000**	$AI_{Dec} = -0.40 - 0.06*T_{Dec} + 0.07*P_{Dec}$
		Southern AEZ	
January	90.94	**0.0000**	$AI_{Jan} = -0.39 - 0.20*T_{Jan} + 0.09*P_{Jan}$
February	85.09	**0.0000**	$AI_{Feb} = -0.79 - 0.10*T_{Feb} + 0.09*P_{Feb}$
March	86.43	**0.0000**	$AI_{Mar} = 0.36 - 0.12*T_{Mar} + 0.03*P_{Mar}$
April	92.16	**0.0000**	$AI_{Apr} = -0.01 - 0.02*T_{Apr} + 0.02*P_{Apr}$
May	96.74	**0.0000**	$AI_{May} = -0.08 - 0.01*T_{May} + 0.01*P_{May}$
June	93.19	**0.0000**	$AI_{Jun} = 1.33 - 0.07*T_{Jun} + 0.01*P_{Jun}$
July	95.05	**0.0000**	$AI_{Jul} = 1.05 - 0.05*T_{Jul} + 0.01*P_{Jul}$
August	94.88	**0.0000**	$AI_{Aug} = 0.55 - 0.03*T_{Aug} + 0.01*P_{Aug}$
September	94.32	**0.0000**	$AI_{Sep} = 0.70 - 0.04*T_{Sep} + 0.01*P_{Sep}$
October	94.62	**0.0000**	$AI_{Oct} = 0.21 - 0.02*T_{Oct} + 0.02*P_{Oct}$
November	87.28	**0.0000**	$AI_{Nov} = -0.25 + 0.02*T_{Nov} + 0.06*P_{Nov}$
December	84.38	**0.0000**	$AI_{Dec} = -0.99 - 0.12*T_{Dec} + 0.10*P_{Dec}$

The regression coefficients show, in what direction and how much may be modified the *E* and *AI* in response to changes in the temperature and precipitation of the respective month. The indicator allows assessing the development of the climate aridity rate throughout the year or during certain periods which are crucial for certain crops or species. The aridity rate was assessed using the following assessment scale: *AI ≤ 0.05 – hyper-arid climate; AI = (0.05 – 0.20) – arid climate; AI = (0.21 – 0.50) – semi-arid climate; AI = (0.51 – 0.65) – dry-sub-humid climate; and AI ≥ 0.65 – sub-humid and humid climate.*

In addition to *AI,* for assessing the AEZs climate the Ivanov's Index of the Biological Effectiveness of the Climate (*IBEC*) (Constantinova et al., 1999, Ţăranu, 2014) was also used. *IBEC* synthesizes the most important climatic variables: precipitation, temperature and relative humidity of the air covered in their annual cycle, as well as the annual heat supply; and well expresses the general ecological background.

An assessment of the Hydrothermal Coefficient (*HTC*) (Selianinov, 1928) was performed to identify the climate change humidity patterns during the plant vegetation period.

5.3.2.2. Summary of Observed Trends for the Humidity Agroclimatic Indices

I. Aridity Index (AI), Potential Evaporation (E) and Ivanov Index of the Biological Effectiveness of the Climate (IBEC)

According to the presented above classification, Tiraspol, Baltata, Chisinau, Leova, Comrat, Cahul was characterized in 1961-2013 years by dry or sub-humid climate (0.50 ≥ *AI* ≤ 0.65), and Briceni, Soroca, Camenca, Ribnita, Balti, Falesti, Bravicea, Cornesti, St-Voda, and Dubasari have had sub-humid and humid climate (*AI* ≥ 0.65), **Table 5-32**.

Table 5-32: The AI and IBEC, Trend Slope (/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, p-value for 1961-2013

Station	AI	Trend	R^2	p-value
Briceni	0.93	-0.04	4	0.1300
Soroca	0.76	-0.04	8	0.0356
Camenca	0.70	-0.02	3	0.2381
Ribnita	0.68	-0.02	2	0.2966
Balti	0.67	-0.03	5	0.1269
Falesti	0.69	-0.04	8	0.0372
Bravicea	0.81	-0.04	8	0.0420
Cornesti	0.82	-0.03	4	0.1709
Dubasari	0.66	-0.02	3	0.2411
Tiraspol	0.62	0.02	2	0.3666
St-Voda	0.70	-0.01	0.5	0.5978
Baltata	0.62	-0.02	2	0.3631
Chisinau	0.61	-0.02	4	0.1659
Leova	0.62	-0.02	4	0.1702
Comrat	0.59	-0.04	9	0.0275
Cahul	0.63	-0.04	8	0.0359

Additional information on the temporal and spatial development of *AI* occurrence throughout the RM is presented in **Figure 5-55**.

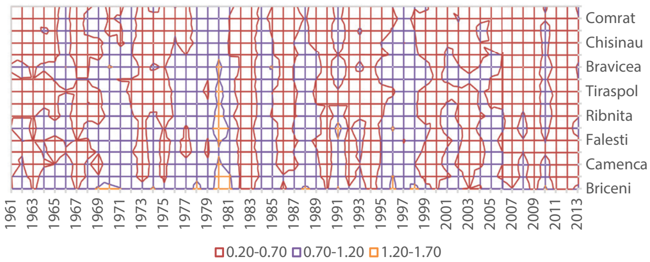


Figure 5-55: The Annual Aridity Index (*AI*) Development throughout the RM in 1961-2013 Time Period.

To assess trends in the change of the annual aridity index *(AI),* the coefficients of the linear trend slope, *(CLTS),* and the coefficients of its determination, R^2, were calculated. The *CLTS* values of the annual *AI* throughout territory of the RM on the average for 1961-2013 have had a negative sign and varied from -0.01 to -0.04 /10 years, however the *AI* trends in 1961-2013-time period mostly are not statistically significant, with the exception of *AI* trends for Camenca, Falesti, Bravicea, Comrat, and Cahul ($p \leq 0.05$), R^2 was from 8% to 9%, which shows a clear trend towards the climate aridization process, **Table 5-32**.

Reduced rainfall in the summer and autumn period, not compensated by a slight increase in winter and spring precipitation, against a background of rising temperatures had led to a strong moisture deficit and sequential increase of the potential evaporation during the 1961-2013 year. The potential evaporation, E_V in vegetation period varied from 598 mm in the North of the country (Briceni) to the 779 in the South (Comrat), with maximum in Chisinau 808 mm, and the annual potential evaporation, $E_{A,}$ varied from 695 to 898, and 932 respectively on the average for 1961-2013 years. For comparison, for the 1961-1990 years the E_V was from 562 mm in the North (Briceni) up to 742 mm in the South (Cahul), Ţăranu, 2014. Additional information on the temporal and spatial development of E_V and E_A during the vegetation throughout the RM is presented in **Figure 5-56** and **Table 5-33**.

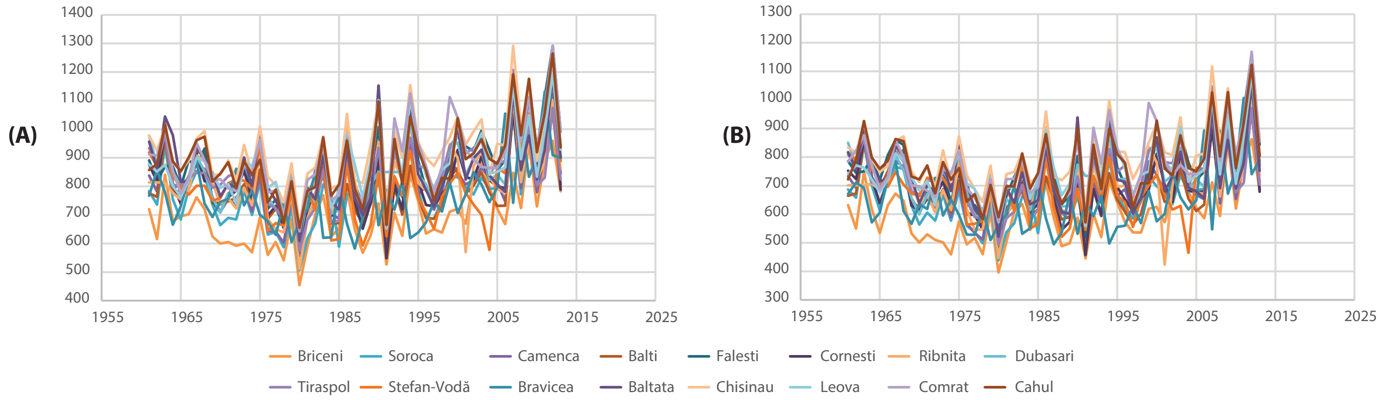


Figure 5-56: The Potential Evaporation (E) mm Development throughout the RM in 1961-2013 time period: (A) Annual Potential Evaporation (E_A) and (B) Potential Evaporation in Vegetation Period (E_V).

The *CLTS* values of E_V on the average for 1961-2013 years, throughout the territory of the RM, were statistically significant, except for Camenca, Balti, Stefan-Voda and Baltata; they had a positive sign and varied from +8.55 to +31.36 mm/10 years, R^2 was from 6% to 18%, which shows an increase in the E_V during the vegetation period in the region. The value of the coefficient of determination, R^2, from 8% to 22% was higher for the annual E_A with a *CLTS* of +13.52 mm/10 years to 43.04 mm/10 years, which shows a statistical significance of the conclusions for changes towards increasing of the E_V and E_A throughout the whole territory of the RM.

The highest growth rate of the E_V and/or E_A was on the average for 1961-2013 from +22.65 and/or +29.01 to +31.39 and/or +43.04 mm/10 years, which was observed in Briceni, Soroca, Falesti, Chisinau, Leova, Comrat, and Cahul and the lowest was +8.55 and/or +13.55 mm/10 years in Baltata, **Table 5-33.**

Table 5-33: The Potential Evaporation, (*E*), Trend Slope (mm/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value* for 1961-2013

Station	E_V	*Trend*	R^2	*p-value*	E_A	*Trend*	R^2	*p-value*
Briceni	598	+27.38	18	**0.0015**	695	+32.49	22	**0.0004**
Soroca	668	+24.62	13	**0.0083**	771	+31.70	18	**0.0014**
Camenca	688	+13.98	5	0.1247	800	+21.47	9	**0.0254**
Ribnita	701	+18.35	7	**0.0622**	814	+2605	12	**0.0121**
Balti	679	+8.90	2	0.3001	790	+14.47	5	0.1173
Falesti	750	+28.80	14	**0.0050**	870	+43.04	26	**0.0000**
Bravicea	641	+17.94	7	**0.0364**	768	+23.67	10	**0.0073**
Cornesti	697	+18.68	6	**0.0759**	818	+22.71	8	**0.0388**
Dubasari	734	+17.94	7	**0.0540**	850	+23.37	11	**0.0173**
Tiraspol	729	+16.17	6	**0.0800**	848	+22.52	10	**0.0220**
St-Voda	704	+11.88	2	0.2890	802	+17.96	4	0.1379
Baltata	736	+8.55	1	0.3848	862	+13.52	3	0.2203
Chisinau	808	+26.83	14	**0.0055**	932	+33.00	18	**0.0018**
Leova	763	+27.99	17	**0.0021**	876	+33.12	20	**0.0008**
Comrat	779	+31.36	17	**0.0019**	898	+38.79	21	**0.0005**
Cahul	774	+22.65	10	**0.0226**	891	+29.01	13	**0.0072**

II. The Selianinov Hydrothermal Coefficient (HTC)

In the RM on the average for 1961-2013 years the *Selianinov Hydrothermal Coefficient* (*HTC*) during the vegetation period ranged from 1.3 in the north (Briceni) up to 0.9 in the south (Comrat), registering values characteristic of moderately dry climate in the former case and of dry climate in the latter case. The assessment of the index has shown that the insufficiency of moisture will become more pronounced.

The *CLTS* values of the *HTC* during the vegetation period on most territory of the RM had a negative sign and varied from -0.01 to -0.06 /10 years, however the *HTC* trends in 1961-2013-time period mostly are not statistically significant, with the exception of *HTC* trends for Cornesti ($p \leq 0.1$), R^2 was by 6%, so an aridization trend is noticeable in the region. Additional information on the temporal and spatial development of *AI* occurrence throughout the RM is presented in **Table 5-34** and **Figure 5-57**.

Table 5-34: The Selianinov Hydrothermal Coefficient (*HTC*), Trend Slope (/10 years), Coefficient of Determination, R^2, and Statistical Significance of Changes, *p-value* for 1961-2013

Station	HTC	Trend	R^2	p-value
Briceni	1.3	-	-	-
Soroca	1.1	-0.04	3	0.2300
Camenca	1.1	-0.03	2	0.3352
Ribnita	1.1	-0.01	0.2	0.7503
Balti	1.1	-0.03	3	0.2496
Falesti	1.1	-0.01	0.3	0.6814
Bravicea	1.2	-0.05	4	0.1638
Cornesti	1.2	-0.06	6	0.0654
Dubasari	1.0	-0.02	1	0.4018
Tiraspol	0.9	-0.01	0.5	0.6139
St-Voda	0.9	-0.004	0.1	0.8526
Baltata	1.0	-0.01	1	0.5687
Chisinau	1.0	-0.01	1	0.6045
Leova	1.1	-	-	-
Comrat	0.9	-0.03	3	0.2194
Cahul	1.0	-0.04	3	0.2226

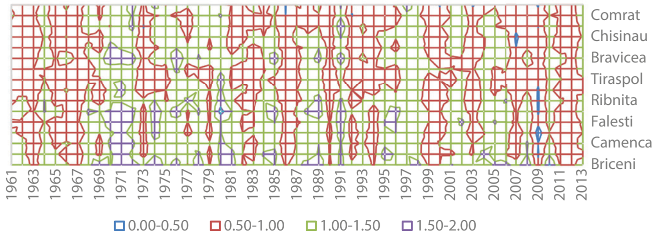


Figure 5-57: The Selianinov Hydrothermal Coefficient (*HTC*) Development throughout the RM in 1961-2013 Time Period.

To analyse the drought conditions during the vegetation period the Hydrothermal Coefficient, (HTC) was calculated by month from April to October and for whole vegetation period (IV-X) for 54 years (1961-2013). As results, the lowest values of the HTC during the vegetation period have been registered in **2009**, between 0.3 (Balti), 0.4 (Soroca, Ribnita, Cornesti, and Dubasari) and 0.5 (Camenca, Bravicea, Chisinau, Leova, and Cahul) at all meteorological stations on the whole territory of the RM a strong drought (HTC ≤ 0.5) was registered, except for Briceni, Falesti, Baltata, Tiraspol and Comrat, where medium drought conditions (HTC = 0.6) were recorded.

Other years with strong and medium drought conditions during the vegetation period on the most territory of the RM were: **1986**, between HTC = 0.5 (Tiraspol, Stefan-Voda, Cahul, and Comrat stations), and HTC = 0.6 (Soroca, Balti, Ribnita, Camenca, Cornesti, Bravicea, Chisinau, and Leova stations); **2007** between HTC = 0.5 (Dubasari, Chisinau, Baltata, and Stefan-Voda stations), and HTC = 0.6 (Balti, Camenca, Ribnita, Tiraspol, Cahul, and Leova stations), and more local strong and medium drought occurrence was registered in **1967**, HTC = 0.5 (Tiraspol, Ribnita, Stefan-Voda, and Comrat stations), **1973**, between HTC = 0.5 (Baltata, Cahul, and Leova stations) and HTC = 0.6 (Stefan-Voda, Chisinau stations); **1999**, between HTC = 0.5 (Soroca, Camenca, and Ribnita), and HTC = 0.6 (Chisinau), **2000**, between HTC = 0.5 (Cahul) and HTC = 0.6 (Bravicea, Baltata, and Comrat), **2003**, between HTC = 0.4 (Cahul), HTC = 0.5 (Ribnita), and HTC = 0.6 (Balti), **Table 5-35**.

Table 5-35: The Selianinov Hydrothermal Coefficient, (*HTC*) Development by Month of the Year throughout the RM in 1961-2013 Time Period

Station	Year	Month of year							
		IV	V	VI	VII	VIII	IX	X	IV-X
Briceni	2009	0.3	0.2	1.6	0.6	0.6	0.1	2.1	0.6
Soroca	1963	0.1	0.6	1.0	1.3	0.5	0.3	0.3	0.7
	1967	0.2	1.6	1.1	0.6	0.8	0.2	0.5	0.7
	1986	1.6	0.1	1.4	0.6	0.4	0.1	0.0	0.6
	1999	0.8	0.3	1.1	0.3	0.6	0.3	0.6	0.5
	2007	0.0	0.2	0.5	0.3	1.1	2.1	0.3	0.7
	2009	0.2	0.1	1.0	0.8	0.2	0.1	0.7	0.4
	2011	0.0	0.8	1.2	0.4	0.3	0.2	1.8	0.6
	2012	1.8	0.7	0.4	0.4	0.5	0.2	0.8	0.6
Camenca	1963	0.1	0.2	1.0	0.7	1.1	0.2	0.1	0.6
	1986	1.3	0.0	1.5	0.7	0.5	0.1	0.3	0.6
	1999	1.0	0.4	0.6	0.2	0.4	0.3	0.7	0.5
	2007	0.1	0.2	0.4	0.4	1.2	1.3	0.8	0.6
	2009	0.1	0.6	0.9	0.7	0.2	0.4	0.7	0.5
	2011	0.0	0.3	1.7	0.5	0.5	0.1	1.7	0.7
	2012	2.0	0.6	0.3	0.8	0.6	0.5	0.9	0.7
Balti	1963	0.2	0.7	0.9	1.5	0.4	0.1	0.4	0.7
	1965		0.7	1.3	0.5	0.1	0.4	0.1	0.6
	1966	0.5	0.6	1.1	0.8	0.6	0.2	0.7	0.7
	1967	0.8	0.6	1.5	0.7	0.4	0.3	0.5	0.7
	1992	1.4	0.7	1.3	0.2	0.2	1.7	0.5	0.7
	1994	0.2	0.5	0.8	0.2	2.0	0.0	1.2	0.7
	2003	0.2	0.4	0.6	1.1	0.3	0.2	2.4	0.6
	2007	0.3	0.3	0.6	0.3	0.6	1.6	0.8	0.6
	2009	0.2	0.2	0.6	0.4	0.2	0.2	1.2	0.3
	2011	0.1	0.4	1.3	0.4	0.3	0.2	1.8	0.6
	2012	1.6	1.1	0.6	0.3	0.4	0.5	1.0	0.7
Ribnita	1963		0.6	0.9	0.7	0.7	0.1	0.1	0.6
	1965		0.9	0.4	1.2	0.3	0.4	0.4	0.7
	1967	0.5	0.8	1.2	0.2	1.0	0.4	0.3	0.6
	1969	0.6	0.7	1.0	0.7	0.5	0.2	0.2	0.6
	1982	2.1	0.1	1.5	1.4	0.3	0.0	1.0	0.7
	1986	0.6	0.0	1.5	0.8	0.6	0.2	0.0	0.6
	1990	1.2	0.8	0.7	0.5	0.3	0.5	0.7	0.6
	1992	1.1	1.1	0.8	0.5	0.4	0.6	1.9	0.7
	1999	1.8	0.3	0.5	0.5	0.3	0.2	1.3	0.5
	2003	0.3	0.0	0.6	1.3	0.2	0.4	1.7	0.5
	2007	0.4	0.1	0.6	0.2	0.7	2.2	0.5	0.6
	2009	0.2	0.3	0.7	0.7	0.2	0.3	1.0	0.4
	2012	1.0	0.5	0.6	0.7	0.4	0.7	1.2	0.7

Station	Year	Month of year							
		IV	V	VI	VII	VIII	IX	X	IV-X
Falesti	1963	0.1	0.1	0.9	0.7	0.8	0.1	0.2	0.5
	1965		0.6	1.6	1.0	0.1	0.4	0.4	0.7
	1992	0.1	1.3	1.0	0.3	0.1	1.7	0.8	0.7
	1994	0.1	1.2	0.9	0.3	1.5	0.3	0.1	0.7
	2009	0.4	0.7	0.8	0.6	0.9	0.4	2.2	0.6
	2012	1.6	0.6	0.2	0.5	0.2	0.5	1.1	0.6
Bravicea	1986	1.0	0.0	1.4	0.5	0.6	0.1	0.3	0.6
	1990	1.1	1.2	1.0	0.6	0.1	0.5	0.7	0.7
	2000	0.5	0.0	0.4	1.3	0.5	1.0	0.3	0.6
	2007	0.7	0.3	1.0	0.1	1.2	0.9	1.5	0.7
	2009	0.0	0.2	0.6	1.0	0.3	0.5	1.6	0.5
	2014	0.1	1.8	0.5	1.3	0.3	0.2	0.1	0.7
Cornesti	1967	0.8	0.7	1.6	0.7	0.6	0.1	0.5	0.7
	1973	0.5	1.5	0.5	1.5	0.2	0.2	0.4	0.7
	1986	1.1	0.1	1.6	0.7	0.3	0.1	0.0	0.6
	1994	0.5	0.8	1.2	0.2	1.2	0.0	0.8	0.7
	2009	0.2	0.3	1.0	0.4	0.4	0.3	1.8	0.4
	2012	1.2	1.1	0.3	0.7	0.4	0.7	1.2	0.7
Dubasari	1961	0.8	2.2	0.2	0.4	0.5	0.2	0.5	0.6
	1962	1.4	0.5	1.1	0.9	0.2	0.5	0.0	0.6
	1963	0.2	0.8	1.3	0.5	0.6	0.1	0.0	0.6
	1967	0.3	0.7	1.8	0.4	0.9	0.4	0.4	0.7
	1973	0.2	1.1	0.3	1.2	0.6	0.3	0.6	0.7
	1986	0.5	0.1	1.7	1.0	0.5	0.0	0.0	0.7
	1990	1.2	1.0	1.1	0.4	0.1	0.4	0.4	0.6
	1999	2.0	0.3	0.5	0.4	0.8	0.5	1.6	0.7
	2000	0.5	0.0	0.3	1.3	0.6	1.6	0.3	0.7
	2003	0.4	0.1	0.5	1.7	0.2	0.7	1.5	0.7
	2007	0.7	0.2	0.2	0.2	1.1	0.7	1.9	0.5
	2009	0.1	0.4	0.3	1.2	0.1	0.4	0.7	0.4
	2011	0.0	0.5	1.6	0.4	0.2	0.1	1.9	0.6
Baltata	1961	1.2	1.5	0.5	0.7	0.6	0.1	0.3	0.7
	1963	0.1	0.6	1.8	0.5	0.6	0.1	0.1	0.7
	1967	0.8	0.3	1.6	0.5	0.7	0.3	0.4	0.7
	1969	0.7	0.4	0.8	1.3	0.7	0.6	0.1	0.7
	1973	0.7	1.3	0.1	0.8	0.2	0.2	0.8	0.5
	1981		1.2	0.4	0.4	0.5	0.7	1.6	0.7
	1986	0.3	0.0	1.6	0.8	0.4	0.1	0.0	0.6
	1992	1.6	0.9	1.7	0.2	0.2	0.6	1.0	0.7
	1994	0.1	0.6	0.7	0.3	1.7	0.0	0.3	0.6
	2000	0.5	0.2	0.3	1.1	0.6	0.9	0.5	0.6
	2003	0.3	0.1	0.4	1.9	0.2	1.3	1.5	0.7
	2007	0.9	0.1	0.9	0.1	0.4	0.5	2.4	0.5
	2009	0.1	0.9	0.4	1.5	0.2	0.5	0.5	0.6
	2011	0.0	1.1	1.9	0.1	0.1	0.1	1.9	0.7
	2012	0.2	0.6	0.3	0.7	0.6	1.4	1.4	0.7
Chisinau	1963	0.1	0.3	1.4	0.8	0.6	0.1	0.1	0.6
	1967	0.4	0.5	1.5	0.2	1.3	0.5	0.5	0.7
	1973	0.9	1.2	0.1	1.1	0.2	0.3	0.5	0.6
	1981		0.8	0.3	0.4	0.5	1.4	1.2	0.7
	1982		0.2	1.1	1.5	0.5	0.1	1.5	0.7
	1986	0.3	0.1	1.9	1.0	0.3	0.0	0.0	0.6
	1990	1.4	0.8	0.8	0.3	0.2	0.6	0.3	0.6
	1992	0.8	1.2	1.3	0.4	0.3	0.6	1.1	0.7
	1999	1.6	0.7	0.6	0.1	0.6	0.5	1.5	0.6
	2000	0.8	0.1	0.1	1.6	0.7	0.8	0.3	0.7
	2003	0.3	0.1	0.3	1.7	0.4	1.1	1.4	0.7
	2007	0.7	0.3	0.4	0.1	0.5	0.5	1.5	0.4
	2009	0.1	0.5	0.6	0.9	0.5	0.4	0.6	0.5
	2012	0.5	1.1	0.3	1.1	0.4	0.7	1.2	0.7

Station	Year	Month of year							
		IV	V	VI	VII	VIII	IX	X	IV-X
Tiraspol	1961	1.5	1.6	0.9	0.4	0.2	0.1	0.4	0.7
	1963	0.1	0.3	1.8	0.6	0.5	0.1	0.1	0.6
	1965	2.6	0.6	0.8	0.7	0.2	0.9	0.6	0.7
	1966	0.4	0.8	1.2	0.8	0.4	0.2	0.7	0.7
	1967	0.3	1.1	0.6	0.3	0.4	0.1	0.6	0.5
	1973	0.2	1.6	0.3	1.3	0.3	0.2	0.5	0.7
	1979	0.0	0.7	1.1	0.6	0.8	0.5	0.3	0.7
	1986	0.4	0.4	0.9	0.6	0.7	0.1	0.0	0.5
	1990	0.7	0.8	0.6	0.3	1.1	0.9	0.3	0.7
	1992	1.0	0.7	1.0	0.5	0.1	0.8	0.7	0.6
	1996	0.0	0.6	0.2	0.1	0.4	3.9	0.0	0.7
	2001	1.1	1.1	1.6	0.3	0.0	1.1	0.0	0.7
	2003	0.6	0.1	0.6	1.0	0.1	1.1	2.5	0.7
	2006	0.1	0.8	3.3	0.4	0.7	0.8	0.3	0.7
	2007	0.7	0.3	0.5	0.0	1.4	0.8	0.3	0.6
	2009	0.3	0.9	0.4	0.6	1.0	0.4	0.5	0.6
	2012	0.4	0.6	0.1	0.9	0.4	1.0	1.7	0.7
	2014	0.8	1.1	0.9	0.5	0.4	0.6	0.0	0.6
Stefan-Voda	1966	0.7	0.7	1.4	0.7	0.5	0.5	0.6	0.7
	1967	0.3	0.9	0.4	0.6	0.6	0.2	0.5	0.5
	1973	0.5	1.2	0.2	1.1	0.3	0.1	0.4	0.6
	1977	3.6	0.5	0.7	1.0	1.0	0.2		0.7
	1982		0.1	1.6	1.0	0.5	0.0	1.4	0.7
	1983	1.6	0.8	1.4	0.8	0.5	0.1	0.2	0.7
	1986	0.3	0.2	0.8	0.4	0.8	0.0	0.0	0.5
	1990	0.5	0.8	0.8	0.4	0.4	1.0	0.2	0.6
	1992	1.6	1.4	0.7	0.2	0.4	0.6	1.0	0.6
	1993	0.6	0.8	1.1	0.5	0.1	1.0	0.2	0.6
	2007	0.6	0.4	0.8	0.0	0.6	0.7	0.7	0.5
	2012	0.9	0.4	0.2	0.4	0.9	1.3	1.7	0.7
Leova	1962	1.3	0.8	0.5	0.6	0.0	0.8	0.0	0.5
	1963	0.4	0.2	1.7	0.6	0.9	0.1	0.0	0.7
	1973	0.3	0.9	0.5	0.6	0.4	0.2	0.1	0.5
	1977	0.3	0.7	0.5	0.6	1.0	0.3		0.7
	1986	0.3	0.0	1.2	1.4	0.6	0.1	0.0	0.6
	1990	0.7	1.2	0.7	0.8	0.1	0.6	0.3	0.6
	1994	0.6	0.5	0.9	0.3	1.4	0.1	0.6	0.6
	1995	0.4	1.0	0.3	0.2	0.8	1.7	0.0	0.6
	2007	1.0	0.6	0.3	0.0	1.6	0.6	0.9	0.6
	2009	0.1	0.6	1.2	0.3	0.2	0.7	0.9	0.5
	2012	0.5	1.6	0.3	0.4	0.7	0.3	1.4	0.7
Comrat	1965	2.2	0.8	1.2	0.5	0.3	0.4	1.2	0.7
	1967	0.5	0.2	0.8	0.6	0.7	0.2	0.4	0.5
	1973	0.2	1.6	0.4	0.7	0.9	0.2	0.2	0.7
	1977	0.7	0.9	0.8	0.7	0.8	0.3		0.7
	1982	1.3	0.1	1.0	0.8	0.6	0.0	0.9	0.6
	1986	0.2	0.1	1.4	0.5	0.8	0.1	0.2	0.5
	1987	1.0	0.6	0.3	0.4	0.8	0.2	1.2	0.5
	1990	0.6	1.1	0.6	0.2	0.7	0.6	0.4	0.6
	1992	0.0	1.1	0.4	0.2	0.2	0.6	1.7	0.5
	1993	0.2	1.2	0.6	0.7	0.3	1.2	0.4	0.7
	1994	0.6	0.2	1.1	0.8	1.2	0.0	0.6	0.7
	1996	0.0	0.4	0.8	0.1	0.4	2.8	0.0	0.6
	2000	0.5	0.2	0.3	0.3	0.6	2.0	0.3	0.6
	2003	0.9	0.3	0.7	1.0	0.4	0.8	1.0	0.7
	2006	0.2	1.0	2.2	0.1	0.7	0.9	0.2	0.7
	2009	0.1	0.3	0.9	0.6	0.9	0.8	0.8	0.6
	2012	0.7	1.4	0.2	0.4	0.8	0.4	1.6	0.7
	2014	1.1	1.6	1.0	0.6	0.6	0.1	0.6	0.7

Station	Year	Month of year							
		IV	V	VI	VII	VIII	IX	X	IV-X
Cahul	1963	0.5	0.2	1.8	0.9	0.5	0.3	0.1	0.7
	1965	1.6	1.0	0.8	0.6	0.5	0.3	1.0	0.7
	1967	0.9	0.4	1.0	0.6	1.1	0.6	0.5	0.7
	1984		1.4	1.1	0.8	0.3	0.3	0.3	0.7
	1986	0.4	0.2	0.6	0.6	0.6	0.3	0.4	0.5
	1990	1.1	0.7	0.7	0.4	0.3	0.5	0.5	0.6
	1992	0.0	0.8	0.6	0.5	0.3	0.6	2.0	0.6
	1995	1.0	1.1	0.6	0.4	0.3	1.8	0.0	0.7
	2000	0.6	0.1	0.3	0.4	0.1	2.0	0.3	0.5
	2003	0.2	0.2	0.2	0.8	0.1	1.3	0.5	0.4
	2006	0.9	0.8	1.1	0.4	0.7	0.8	0.3	0.7
	2007	0.7	0.4	0.5	0.0	1.4	0.8	0.3	0.6
	2009	0.5	0.7	0.3	0.5	0.3	0.8	0.8	0.5
	2011	0.3	0.9	1.5	0.6	0.4	0.0	1.9	0.7

HTC > 1 - sufficient humidity	
HTC ≤ 0.7 - drought conditions	
HTC = 0.6 - medium drought	
HTC ≤ 0.5 - strong drought	

On the whole, over the 54 years (1961-2013) drought conditions HTC ≤ 0.7, were registered from 2% (Briceni), 11% (Cornesti, Falesti), 13-15% (Soroca, and Camenca) up to 20-24% (Balti, and Ribnita) in Northern AEZ; from 11% (Bravicea) up to 24-28% (Dubasari, Chisinau, and Baltata) in Central, and from 20-22% (Stefan-Voda, and Leova), 26% (Cahul) up to 33% (Tiraspol, and Comrat) in Southern AEZs. The HTC values show that medium and strong drought (HTC ≤ 0.6) condition varied for the 54 years (1961-2013) from 2% (Briceni), 4-6% (Cornesti, Falesti), 9% (Soroca, Camenca, Balti) up to 17 % (Ribnita) in Northern AEZ; from 6% (Bravicea) up to 11-13% (Baltata, Chisinau, Dubasari) in Central, and from 13% (Tiraspol, Stefan-Voda, and Cahul), 15% (Leova) up to 17% (Comrat) in Southern AEZ. The strong drought conditions during vegetation period HTC ≤ 0.5 have varied for the 54 years (1961-2013) from 2-6% in Northern up to 6-7% in Southern AEZs.

III. The Ivanov's Index of Biological Effectiveness of the Climate (IBEC)

In the RM on the average for 1961-2013 years the *Ivanov's Index of Biological Effectiveness of the Climate (IBEC)* during the vegetation period ranged from 26.46 in the north (Briceni) up to 20.24 in the south (Comrat). It is estimated that the area of ecological optimum corresponds to *IBEC* =22. The area with the corresponding value of *IBEC* is a kind of environmental axis or core, of which the natural habitat conditions deteriorate, on the one hand, to the north (due to the general reduction of the heat supply), on the other hand, to the south (due to reduced natural moisture availability on the territory and at the same time enhanced thermal discomfort due to excessive heat). The assessment of that index has shown that the insufficiency of moisture will become more pronounced in the future.

The *CLTS* values of the *IBEC* during the vegetation period on most territory of the RM had a negative sign and varied from -0.01 to -1.03/10 years, however the *IBEC* trends in 1961-2013 period mostly are not statistically significant, with the exception of *IBEC* trend for Soroca ($p \leq 0.1$), R^2 was by 6%, so a trend to worsening of optimal ecological-climatic characteristics for plant growing can be noted in the RMs Central and Southern AEZs. Additional information on the temporal and spatial development of *IBEC* Index throughout the RM is presented in **Table 5-36** and **Figure 5-58**.

Table 5-36: The IBEC, Trend Slope (/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, p-value for 1961-2013

Station	IBEC	Trend	R^2	p-value
Briceni	26.46	-0.56	2	0.8101
Soroca	22.81	-1.03	6	**0.0712**
Camenca	22.02	-0.42	1	0.3939
Ribnita	21.21	-0.12	0.1	0.8357
Balti	21.21	-0.50	2	0.3544
Falesti	22.49	-0.62	2	0.2651
Bravicea	26.05	-0.74	3	0.2560
Cornesti	25.27	-0.31	0.4	0.6466
Dubasari	22.36	-0.12	0.1	0.8253
Tiraspol	20.56	-0.01	0.0	0.9656
St-Voda	23.30	-0.06	0.0	0.9107
Baltata	20.22	-0.12	0.1	0.8145
Chisinau	20.41	-0.22	0.4	0.6425
Leova	20.79	-0.39	1	0.4713
Comrat	20.24	-0.77	4	0.1391
Cahul	21.29	-0.79	4	0.1472

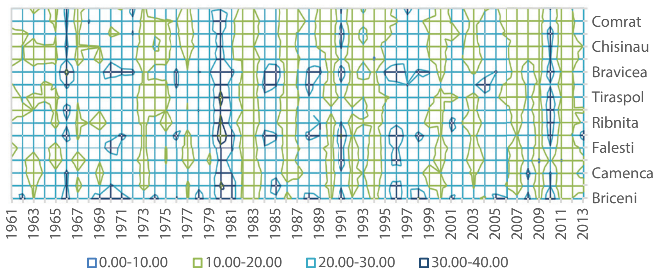


Figure 5-58: The Ivanov Index of the Biological Effectiveness of the Climate (IBEC).

5.3.2.3. Projections of Future Changes in Humidity Agroclimatic Indices throughout the RM´s AEZs in XXI Century According to the CMIP5 Ensemble of 21 GCMs

I. Projections of Future Changes in Aridity Index (AI) and Potential Evaporation (E)

The aridity rate was assessed using the following assessment scale: AI ≤ 0.05 – hyper-arid climate; AI = (0.05 – 0.20) – arid climate; AI = (0.21 – 0.50) – semi-arid climate; AI = (0.51 – 0.65) – dry-sub-humid climate; and AI ≥ 0.65 – sub-humid and humid climate.

According to the above classification, most of the RM's territory is characterized currently with dry or sub-humid climate (0.50 ≥ AI ≤ 0.65). Certain areas in the South-East have semi-arid climate (AI ≥ 0.48), and Northern zone and the areas with altitudes above 350-400 meters above sea level have sub-humid and humid climate (AI ≥ 0.65).

The dynamics of spatial changes in humidity conditions over the century, expressed in annual AI is shown in **Figure 5-59**.

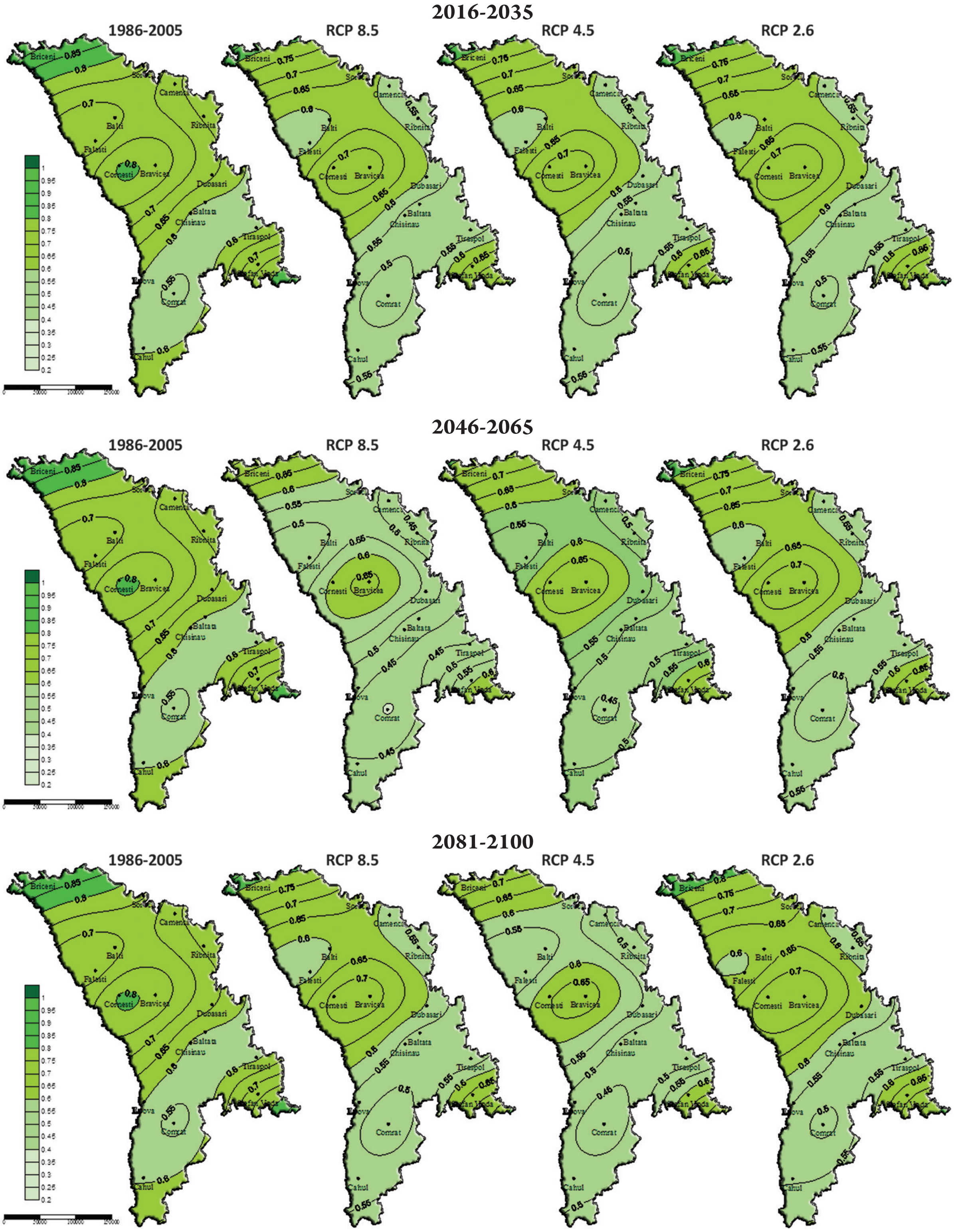


Figure 5-59: Projected CMIP5 21 GCMs Ensemble Annual Aridity Index (AI) Development throughout the RM.

It is evident that the RM is moving towards a dryer climate, from dry or sub-humid climate to dry sub-humid and semi-arid climate. For all three RCPs scenarios worsening of the humidity conditions throughout the territory of the RM is expected. Reduced rainfall in the summer and autumn period (not compensated by a slight increase in winter and spring precipitation) against a background of rising temperatures will cause strong moisture deficit and sequential increase of the potential evaporation during the XXI century.

Potential evaporation is likely to increase by 7-11 per cent during the growing season over the 2016-2035 period, and run up to 42-47 per cent by the 2081-2100 period and make from 1022 mm[186] for the Northern to 1312 mm in the Southern AEZs under the scenario RCP8.5. The lowest growth is projected according to the RCP2.6 scenario, by 10-11 per cent, from 779 mm for the Northern, to 990 mm in the Southern AEZs, as compared to the baseline climate, **Table 5-37**.

[186] For comparison purposes, it is worth noting that the observed mean PE during the growing season in the reference period (1981-2005) was as follows: Briceni – 702 mm; Chisinau – 950 mm; Cahul – 891 mm.

Table 5-37: Projected CMIP5 21 GCMs Ensemble Changes in the PE and AI during the growing season, under Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986-2005 Climatological Baseline Period in XXI Century

AEZ	RCP8.5				RCP4.5				RCP2.6			
	PE		AI		PE		AI		PE		AI	
	mm	%	Index	%	mm	%	Index	%	mm	%	Index	%
2016-2035												
Northern	774	+10	0.81	-10	768	+9	0.81	-10	762	+9	0.82	-9
Central	1039	+9	0.54	-10	1035	+9	0.53	-12	1018	+7	0.55	-8
Southern	987	+11	0.52	-12	981	+10	0.52	-12	966	+8	0.54	-8
2046-2065												
Northern	871	+24	0.71	-21	820	+17	0.76	-16	782	+11	0.81	-10
Central	1160	+22	0.48	-20	1097	+15	0.51	-15	1051	+11	0.54	-10
Southern	1111	+25	0.45	-24	1044	+17	0.49	-17	996	+12	0.52	-12
2081-2100												
Northern	1022	+46	0.57	-37	852	+21	0.74	-18	779	+11	0.83	-8
Central	1352	+42	0.38	-37	1136	+20	0.49	-18	1043	+10	0.56	-7
Southern	1312	+47	0.34	-42	1088	+22	0.47	-20	990	+11	0.54	-8

Note: *The observed mean PE and AI during the growing season for reference period (1986-2005) were as following: PE - Briceni (702mm); Chisinau (950mm); Cahul (891mm); AI – Briceni (0.90); Chisinau (0.60); Cahul (0.59).*

The obtained results allow conclude that in the future the climate aridization process during the growing season may accelerate considerably on the territory of the RM. Thus, already in the early 2016-2035 period that process would intensify noticeably as compared to the reference period of 1986-2005, **Figure 5-60**. That phenomenon will be pronounced during the whole vegetation period from April to September in Central and May to September in Southern AEZs according to all RCPs scenarios.

By the 2081-2100 period the climate aridization will be felt during the whole vegetation period (April to September); it will be much more pronounced and may result in values characteristic to the semi-arid climate (AI = 0.21-0.50). As compared to reference period (1986-2005), all climatic scenarios applied for the assessment purposes, have demonstrated that the aridity would be highest in July and August (in the case of RCP8.5 scenario), achieving in respective periods values characteristic to arid climate conditions (AI = 0.05-0.20).

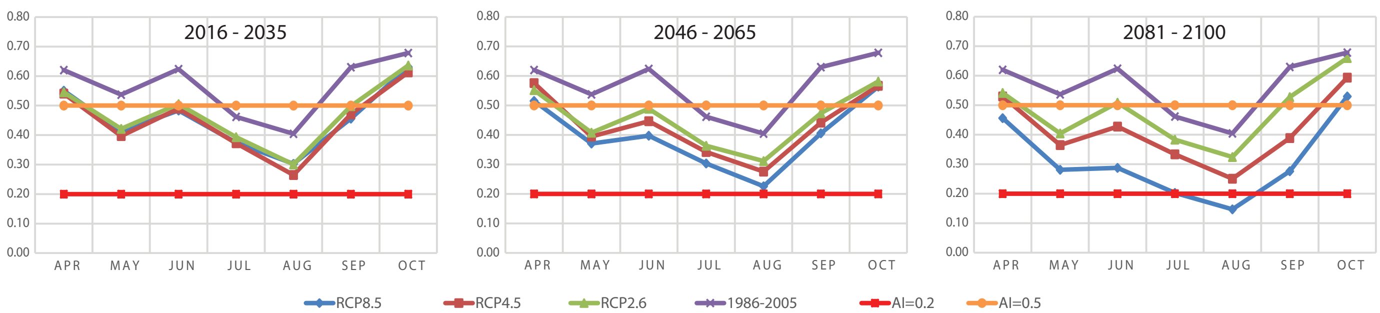


Figure 5-60: Projections of the Aridity Index (AI) Development Pattern for Southern AEZ of the RM from CMIP5 Ensemble of 21 Global Models for Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, as Compared to the 1986-2005 Climate Reference Period.

II. Projections of Future Changes in Selianinov Hydrothermal Coefficient (HTC)

In the RM, the baseline 1986-2005 climatic conditions HTC ranges from 1.4 in the North to 0.8-0.9 in the South-East of the country, it registers values characteristic of the moderately dry climate in the former case and of the dry climate in the latter case. The assessment of that index has shown that the insufficiency of moisture would become more pronounced in the future as compared to the climate of the reference period, while **Figure 5-61** clearly demonstrates the gradual aridization in the future of the RM territory, including northern areas, which today are still sufficiently wet.

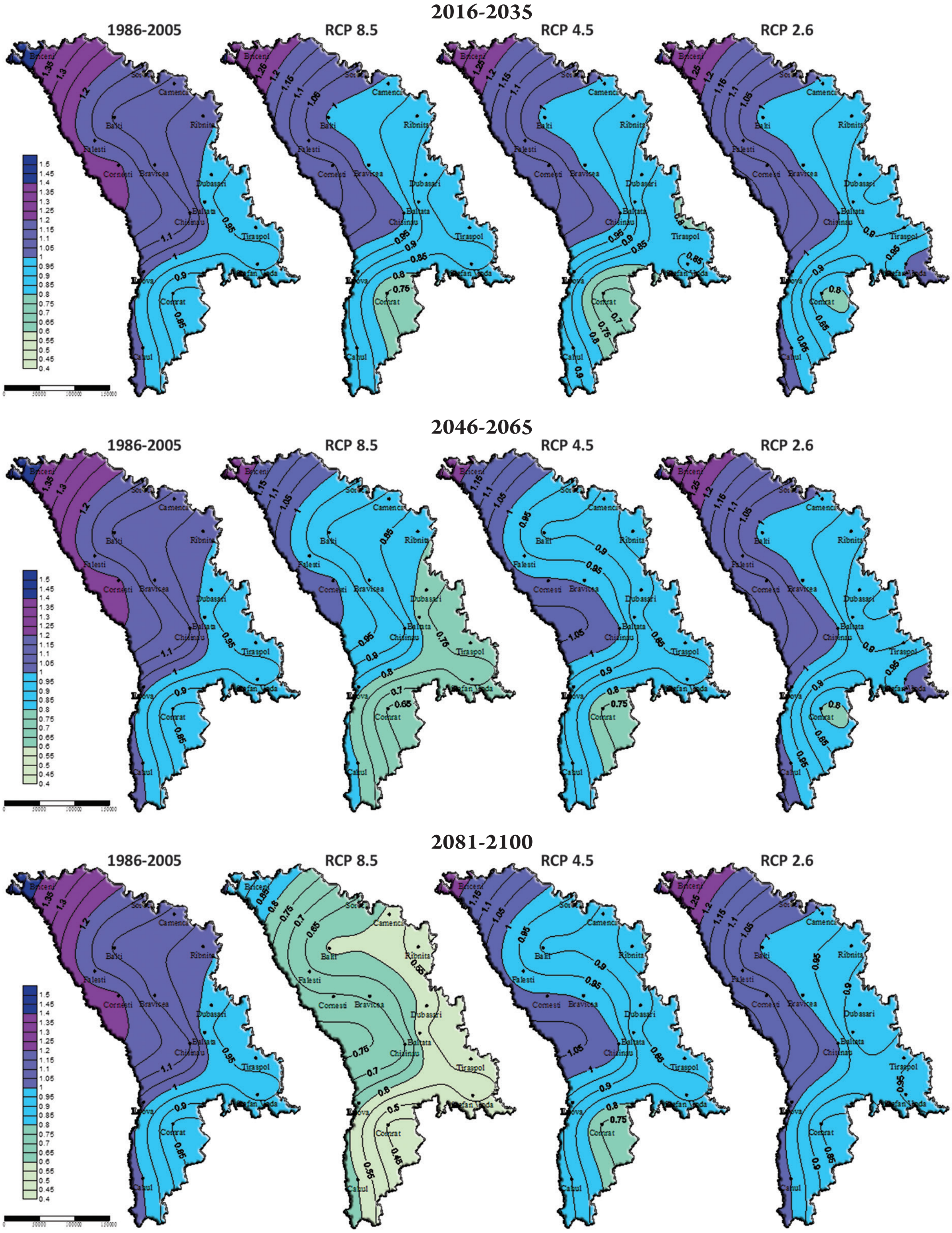


Figure 5-61: Projected CMIP5 21 GCMs Ensemble HTC Index Development for the Vegetation Period throughout the RM.

In the **Table 5-38** it is provided the characterization of humidity conditions during the plant vegetation period using the Selianinov Hydrothermal coefficient (HTC) for the 1986-2005 reference period, and projected ensemble changes in the HTC during the growing season for RCPs 8.5, 4.5 and 2.6 emissions scenarios relative to the 1986-2005 climatological baseline period in XXI century. Analysis of data shows that by the 2081-2100 time the drought conditions of HTC ≤ 0.7 will be observed on the whole territory of Moldova including the Northern AEZ (in August). Furthermore, under RCP8.5 scenario in the Central (July, August) and Southern AEZs in July, August, and September those levels can achieve even the values characteristic of the medium drought (HTC = 0.6) and strong drought (HTC ≤ 0.5) (**Figure 5-62**; **Table 5-38**).

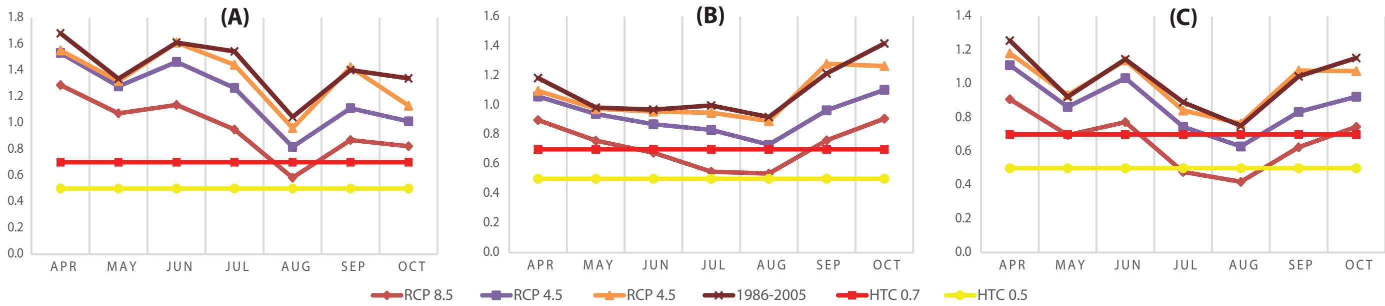


Figure 5-62: Projected Ensemble Changes in the Selianinov Hydrothermal Coefficient (HTC) during the growing season by the 2081–2100 for Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986–2005 Climatological Baseline Period: (A) Briceni, (B) Chisinau, (C) Cahul.

Table 5-38: Projected CMIP5 21 GCMs Ensemble Changes in the HTC during the growing season, under Representative Concentration Pathways, RCP8.5, RCP4.5, and RCP2.6, Relative to the 1986-2005 Climatological Baseline Period in XXI Century

AEZs	Scenario	Month of the year							
		IV	V	VI	VII	VIII	IX	X	IV-X
				1986-2005					
Northern	*Baseline climate*	1.7	1.3	1.6	1.5	1.0	1.4	1.3	**1.4**
Central		1.2	1.0	1.0	1.0	0.9	1.2	1.4	**1.1**
Southern		1.3	0.9	1.1	0.9	0.8	1.0	1.2	**1.0**
				2016-2035					
Northern	RCP8.5	1.6	1.3	1.6	1.4	0.9	1.2	1.1	**1.3**
	RCP4.5	1.6	1.3	1.6	1.4	0.8	1.3	1.2	**1.3**
	RCP2.6	1.6	1.3	1.5	1.4	0.9	1.3	1.2	**1.3**
Central	RCP8.5	1.1	1.0	0.9	0.9	0.9	1.1	1.2	**1.0**
	RCP4.5	1.1	1.0	0.9	0.9	0.8	1.1	1.2	**1.0**
	RCP2.6	1.1	1.0	0.9	0.9	0.8	1.2	1.3	**1.0**
Southern	RCP8.5	1.2	0.9	1.1	0.8	0.7	0.9	1.0	**0.9**
	RCP4.5	1.2	0.9	1.1	0.8	0.6	1.0	1.0	**0.9**
	RCP2.6	1.2	1.0	1.1	0.9	0.7	1.0	1.1	**1.0**
				2046-2065					
Northern	RCP8.5	1.4	1.3	1.4	1.2	0.8	1.1	1.0	**1.2**
	RCP4.5	1.6	1.3	1.5	1.3	0.9	1.2	1.0	**1.2**
	RCP2.6	1.6	1.4	1.5	1.4	0.9	1.3	1.1	**1.3**
Central	RCP8.5	1.0	0.9	0.8	0.8	0.7	1.0	1.0	**1.0**
	RCP4.5	1.1	1.0	0.9	0.9	0.8	1.1	1.1	**1.0**
	RCP2.6	1.1	1.0	0.9	0.9	0.9	1.1	1.2	**1.0**
Southern	RCP8.5	1.1	0.9	1.0	0.7	0.6	0.9	0.9	**0.9**
	RCP4.5	1.2	0.9	1.1	0.8	0.7	0.9	0.9	**0.9**
	RCP2.6	1.2	0.9	1.1	0.8	0.7	1.0	1.0	**1.0**
				2081-2100					
Northern	RCP8.5	1.3	1.1	1.1	0.9	0.6	0.9	0.8	**0.9**
	RCP4.5	1.5	1.3	1.5	1.3	0.8	1.1	1.0	**1.2**
	RCP2.6	1.6	1.3	1.6	1.4	1.0	1.4	1.1	**1.3**
Central	RCP8.5	0.9	0.8	0.7	0.5	0.5	0.8	0.9	**0.7**
	RCP4.5	1.1	0.9	0.9	0.8	0.7	1.0	1.1	**0.9**
	RCP2.6	1.1	1.0	1.0	0.9	0.9	1.3	1.3	**1.0**
Southern	RCP8.5	0.9	0.7	0.8	0.5	0.4	0.6	0.7	**0.6**
	RCP4.5	1.1	0.9	1.0	0.7	0.6	0.8	0.9	**0.8**
	RCP2.6	1.2	0.9	1.1	0.8	0.8	1.1	1.1	**1.0**

III. Projections of Future Changes in Ivanov's Index of Biological Effectiveness of the Climate

The Ivanov Index of the Biological Effectiveness of the Climate (IBEC) synthesizes the most important climatic variables: precipitation, temperature and relative humidity of the air covered in their annual cycle, as well as the annual heat supply; and it expresses well the general ecological background. It is estimated that the area of ecological optimum corresponds to IBEC = 22.

The area with the corresponding value of IBEC is a kind of environmental axis or core, from which the natural habitat conditions deteriorate, on the one hand, towards the north (due to the general reduction of the heat supply), on the other hand, towards the south (due to reduced natural moisture availability of the territory and at the same time enhance of thermal discomfort due to excessive heat). This clearly shows the latitude-zonal pattern of climate variability.

Projected CMIP5 21Multi - Model Ensemble Ivanov Index of the Biological Effectiveness of Climate (IBEC) Development throughout the RM presented in **Figure 5-63** clearly demonstrates the gradual worsening of optimal ecological-climatic characteristics for plant growing on the RM's territory, including in the northern areas by the 2081-2100 period especially for RCP8.5 and RCP4.5 scenarios.

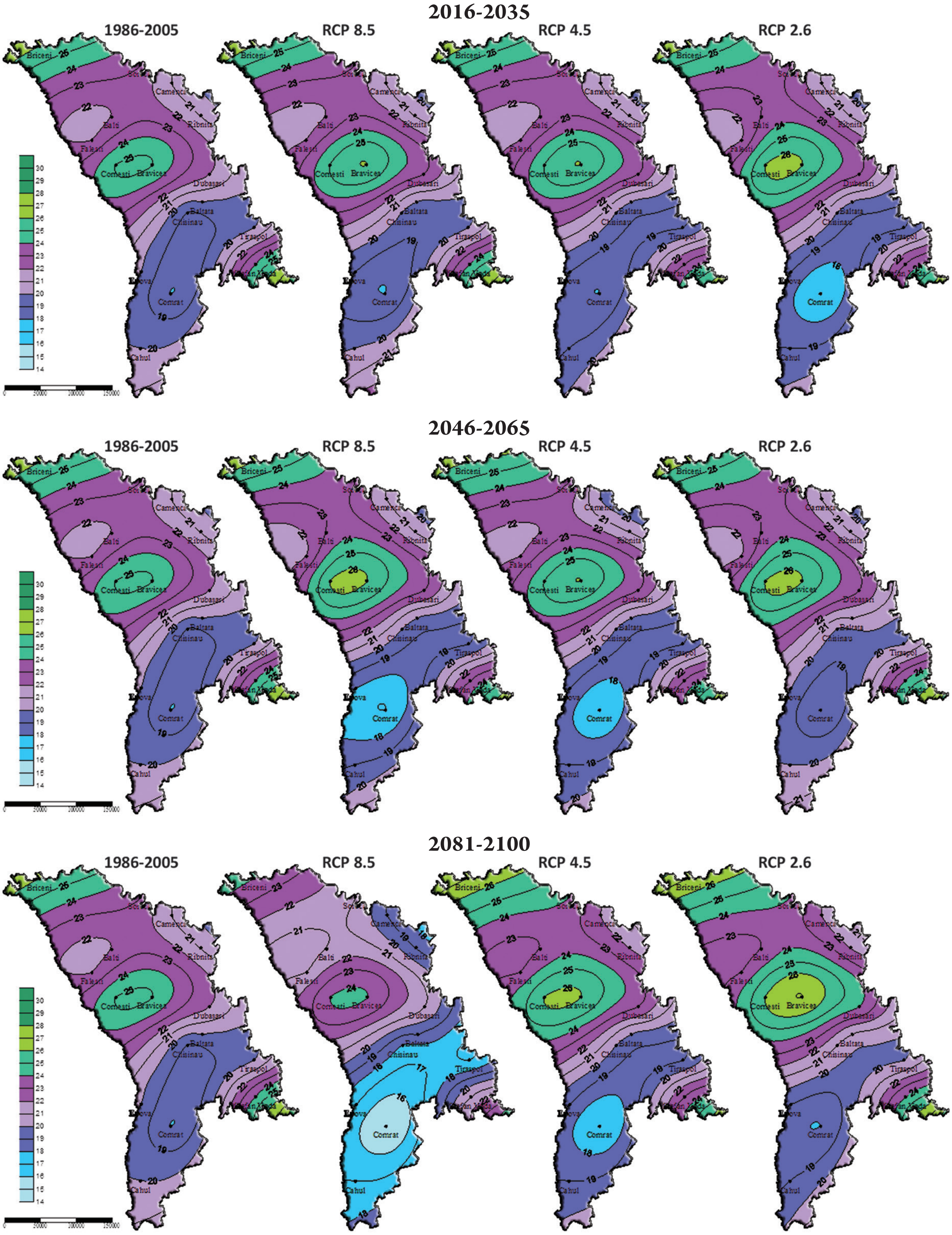


Figure 5-63: Projected CMIP5 21 GCMs Ensemble Ivanov Index of the Biological Effectiveness of Climate (IBEC) Development throughout the RM.

5.4. Climate Change Impacts and Vulnerabilities in the RM

5.4.1. Climate Change and Major Annual Crop Production

The possible changes in the yield of major agricultural crops (*winter wheat, grain maize, sunflower, sugar beet and tobacco*), due to future climate changes in the RM, without undertaking any adaptation measures, is shown in **Figure 5-64**.

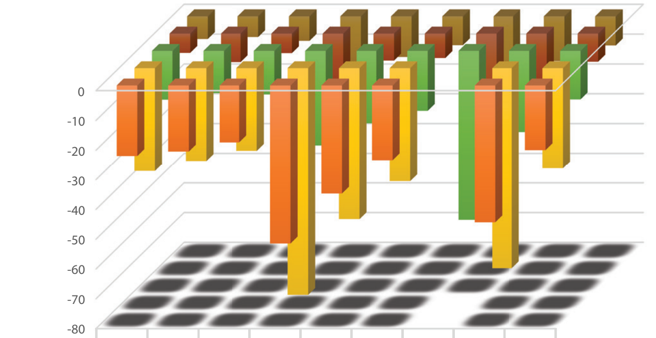
The impact assessment performed on national level allows concluding that the negative effect of global warming, according to the CMIP5 Ensemble of 21 GCMs for RCP8.5, RCP4.5, and RCP2.6 scenarios in the XXI century will not be offset by increase of precipitations. In these circumstances, without undertaking any adaptation measures, the following can be expected by 2100: a significant drop in the productivity for grain corn, from 34% (RCP2.6) to 67% (RCP4.5); in winter wheat, from 22% (RCP2.6) to 46% (RCP4.5); a medium drop in the productivity for sunflower from 16% (RCP2.6) to 57% (RCP8.5), respectively for sugar beet, from 9% (RCP2.6) to 37% (RCP8.5); and for tobacco, from 10% (RCP2.6) to 30% (RCP8.5), in comparison with the average productivity of the RM's major agricultural crops in the most recent period of 1981-2010. Due to changes in climatic conditions in the RM, by the end of the XXI century, the cultivation of grain corn and winter wheat will be impossible according to the RCP8.5 scenario.

5.4.1.1. Projections of Future Changes in Winter Wheat Yield

Additionally, to the national level, have been assessed the impact of temperature and precipitation during the growing season on agricultural crops productivity in the RM's territorial administrative units (district level), in order to distinguish the most and least vulnerable districts to climate change.

According to projections, the most vulnerable districts for cultivation of winter wheat will be Basarabeasca, Taraclia, Cimislia, Causeni, Cahul, and Stefan Voda in Southern, and Dubasari, Anenii Noi, Hincesti, Ialoveni, Nisporeni, Criuleni, Telenesti and Orhei, in Central AEZs, in which productivity of the winter wheat may decrease from 19-26% (RCP2.6) to 52-63% (RCP4.5) by 2100.

The least vulnerable districts for winter wheat production will be Donduseni, Briceni, Riscani, Soroca, and Singerei in the Northern AEZ; and Ungheni, Calarasi and Soldanesti in Central AEZs, in which productivity of the winter wheat by 2100 could decrease from 8 to 28% (RCP2.6) and/or from 69 to 94% (RCP8.5) (**Table 5-39**).



	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6
	2016-2035			2046-2065			2081-2100		
Winter wheat	-24	-22	-19	-53	-36	-25		-46	-22
Grain maize	-35	-31	-28	-76	-51	-38		-67	-34
Sunflower	-16	-14	-15	-32	-24	-20	-57	-27	-16
Sugar beet	-6	-10	-7	-18	-9	-8	-37	-17	-9
Tobacco	-8	-7	-8	-18	-14	-10	-30	-15	-10

Figure 5-64: Projections of Future Changes in Productivity of Major Agricultural Crops in the RM, (%/20 years) Relative to 1981-2010 Current Period, According to the CMIP 5 Ensemble of 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6

Table 5-39: Projected Winter Wheat Yield Changes, (%/20 Year), under the CMIP5 Ensemble of 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the Current Situation (1981-2010)

AEZs/ district	1981-2010, q/ha	2016-2035			2046-2065			2081-2100		
		RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6
Northern AEZ										
Briceni	33.5	-19	-20	-19	-41	-31	-22	-75	-39	-22
Donduseni	29.0	-23	-18	-20	-49	-35	-23	-90	-41	-19
Drochia	32.1	-14	-13	-16	-36	-25	-19	-81	-37	-19
Edinet	30.0	-17	-19	-15	-45	-26	-23	-86	-42	-24
Falesti	32.4	-27	-23	-22	-56	-38	-28		-52	-26
Floresti	29.3	-29	-26	-25	-64	-42	-30		-57	-29
Glodeni	33.6	-24	-20	-20	-52	-35	-25	-97	-48	-24
Ocnita	30.4	-21	-24	-19	-49	-30	-28	-91	-47	-28
Riscani	31.4	-15	-16	-13	-37	-22	-20	-69	-34	-21
Singerei	30.6	-18	-19	-14	-45	-29	-24	-83	-42	-28
Soroca	29.5	-16	-17	-13	-40	-25	-21	-76	-38	-24
Central AEZ										
Anenii Noi	28.1	-29	-27	-23	-73	-48	-32		-63	-26
Calarasi	24.9	-17	-16	-14	-46	-30	-19	-89	-39	-16
Criuleni	30.4	-22	-20	-14	-60	-39	-25		-52	-19
Dubasari	29.6	-26	-25	-20	-71	-47	-30		-62	-24
Hincesti	27.1	-26	-24	-20	-67	-44	-28		-58	-23
Ialoveni	26.6	-26	-24	-20	-66	-44	-28		-57	-23
Nisporeni	27.3	-23	-22	-19	-66	-43	-27		-57	-21
Orhei	28.3	-27	-25	-21	-65	-44	-29		-56	-25
Rezina	25.0	-24	-22	-19	-56	-38	-25		-48	-21
Straseni	26.5	-22	-20	-17	-55	-36	-24		-47	-21
Soldanesti	25.5	-21	-19	-16	-48	-32	-21	-94	-41	-18
Telenesti	25.1	-29	-26	-21	-66	-44	-30		-57	-25
Ungheni	30.9	-11	-9	-6	-32	-20	-11	-69	-27	-8
Southern AEZ										
Basarabeasca	25.5	-25	-24	-17	-68	-46	-30		-63	-27
Cahul	26.4	-24	-24	-19	-64	-43	-29		-56	-24
Cantemir	26.4	-19	-18	-13	-45	-30	-20	-88	-40	-17
Causeni	26.6	-24	-23	-17	-62	-42	-28		-57	-23
Cimislia	26.1	-25	-24	-18	-61	-43	-29		-57	-26
Leova	26.1	-20	-19	-14	-47	-32	-22	-92	-42	-19
Stefan Voda	30.2	-24	-23	-18	-60	-41	-29		-56	-24
Taraclia	28.7	-24	-23	-16	-63	-42	-27		-58	-24

5.4.1.2. Projections of Future Changes in Grain Corn Yield

Due to climate change the most vulnerable for grain corn cultivation would be the Central and – to a less extent the Northern and Southern AEZs. The most vulnerable districts will be Orhei, Anenii Noi, Straseni, Ialoveni, Nisporeni, Telenesti, Ungheni, Calarasi, Criuleni and Dubasari; and ATU Gagauzia, Basarabeasca, Cahul, Taraclia, and Stefan Voda in Southern AEZ, in which productivity of the grain corn may decrease by 2100 from 28 to 50% (RCP2.6) and/or up to 58-91% (RCP4.5). The significant drop in grain corn yield from 65 to 100% under RCP8.5 scenario is projected also in Northern AEZ by 2100 relative to 1981-2010 reference period.

The least vulnerable districts to climate change will be Donduseni, Drochia, Falesti, and Ocnita in Northern; Rezina, and Soldanesti in Central, and Leova in Southern AEZs, in which productivity of the grain corn may decrease by 2100, in dependence of the assessed scenario from 7 to 23% (RCP2.6) and/or from 25 to 49% (RCP8.5).

Without adaptation, due to changes in climatic conditions in the most districts of the RM, by the end of the XXI century, the cultivation of grain corn and winter wheat will be impossible according to the RCP8.5 high warming scenario or economically not cost effective under the RCP4.5 medium warming scenario (**Table 5-40**).

Table 5-40: Projected Grain Corn Yield Changes, (%/20 Year), under the CMIP5 Ensemble of 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the Current Situation (1981-2010)

AEZs/ district	1981-2010, q/ha	2016-2035			2046-2065			2081-2100		
		RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6
Northern AEZ										
Briceni	36.0	-52	-51	-46		-88	-60			-50
Donduseni	28.9	-16	-15	-17	-35	-30	-16	-65	-25	-7
Drochia	25.1	-22	-24	-19	-49	-34	-25	-88	-34	-17
Edinet	28.6	-40	-37	-33	-87	-59	-41		-66	-31
Falesti	24.2	-19	-23	-20	-48	-33	-25	-88	-45	-29
Floresti	28.6	-46	-48	-40		-76	-55			-48
Glodeni	29.1	-33	-32	-27	-77	-49	-33		-56	-23
Ocnita	36.7	-21	-19	-16	-52	-34	-20	-93	-38	-16
Riscani	31.1	-38	-38	-29	-98	-62	-43		-73	-33
Singerei	26.2	-46	-45	-38		-76	-52		-90	-42
Soroca	30.7	-37	-38	-33	-90	-60	-40		-71	-33
Central AEZ										
Anenii Noi	25.3	-44	-48	-41		-78	-54			-47
Calarasi	24.8	-35	-36	-32	-89	-60	-41		-77	-37
Criuleni	28.5	-53	-48	-44		-76	-54		-91	-44
Dubasari	28.6	-45	-43	-38		-68	-49		-83	-41
Hincesti	24.9	-35	-37	-31	-85	-57	-40		-72	-35
Ialoveni	26.5	-42	-44	-38		-71	-49		-89	-43
Nisporeni	27.5	-43	-44	-38		-71	-49		-88	-43
Orhei	24.0	-49	-51	-44		-82	-57			-50
Rezina	24.3	-24	-24	-17	-57	-37	-26		-49	-23
Straseni	23.8	-45	-45	-39		-74	-51		-93	-44
Soldanesti	23.6	-23	-25	-18	-55	-35	-26		-46	-22
Telenesti	19.7	-38	-41	-34	-89	-59	-43		-73	-36
Ungheni	34.3	-29	-28	-23	-68	-46	-32		-58	-28
Southern AEZ										
Basarabeasca	24.8	-30	-33	-27	-76	-52	-33		-69	-34
Cahul	27.0	-42	-42	-35	-99	-67	-47		-85	-40
Cantemir	23.8	-27	-29	-25	-64	-43	-30		-52	-25
Causeni	25.1	-31	-32	-28	-73	-49	-35		-60	-28
Cimislia	20.6	-31	-33	-26	-84	-54	-33		-69	-33
Leova	24.7	-21	-24	-19	-54	-36	-24		-45	-21
Stefan Voda	26.5	-31	-30	-26	-69	-47	-34		-58	-28
Taraclia	27.6	-31	-33	-28	-77	-52	-35		-65	-30
ATU Gagauzia	26.0	-32	-35	-29	-82	-55	-37		-69	-32

5.4.1.3. Projections of Future Changes in Sunflower Yield

The most vulnerable for sunflower cultivation without application of adaptation measures, would be Central AEZ and, to less extent, Northern and Southern AEZs. According to projections, the most vulnerable districts will be Ialoveni, Hincesti, Straseni, Telenesti, Anenii Noi, Dubasari, and Orhei in Central AEZ, in which productivity of sunflower by 2100 may decrease from 23 to 37% (RCP2.6) and/or from 44 to 76% (RCP4.5).

The least vulnerable for sunflower cultivation districts will be Floresti, Falesti, Riscani, Briceni, Donduseni, Drochia, Edinet, Ocnita, Singerei, and Soroca in Northern AEZ in which productivity of sunflower may decrease by 2100, from 4 to 15% (RCP2.6) and/or from 17 to 40% (RCP4.5). Without adaptation measures due to changes in climatic conditions in the most districts of the RM, by the end of the XXI century, the cultivation of sunflower will be impossible or economically not cost effective according to the RCP8.5 high warming scenario (**Table 5-41**).

Table 5-41: Projected Sunflower Yield Changes, (%/20 Year), under the CMIP5 Ensemble of 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the Current Situation (1981-2010)

AEZs/ district	1981-2010, q/ha	2016-2035			2046-2065			2081-2100		
		RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6
Northern AEZ										
Briceni	16.3	-21	-16	-16	-53	-35	-22	-97	-40	-15
Donduseni	15.4	-20	-17	-17	-51	-33	-20	-95	-39	-14
Drochia	18.3	-20	-16	-16	-49	-31	-20	-91	-37	-13
Edinet	17.0	-19	-17	-17	-49	-31	-20	-93	-37	-14
Falesti	16.2	-9	-8	-8	-25	-15	-11	-51	-22	-9
Floresti	15.7	-9	-7	-9	-24	-15	-8	-46	-17	-4
Glodeni	19.7	-16	-12	-14	-40	-25	-15	-76	-31	-10
Ocnita	16.5	-17	-15	-15	-43	-27	-18	-82	-33	-13
Riscani	16.4	-5	-4	-5	-17	-10	-5	-35	-12	-1
Singerei	17.2	-12	-11	-11	-33	-20	-14	-65	-27	-11
Soroca	15.4	-10	-7	-9	-26	-17	-8	-50	-19	-4
Central AEZ										
Anenii Noi	12.2	-36	-32	-32	-74	-55	-42		-63	-33
Calarasi	11.7	-22	-19	-19	-49	-32	-27	-90	-46	-26
Criuleni	15.2	-29	-25	-25	-60	-44	-35		-51	-28
Dubasari	13.3	-29	-27	-26	-66	-46	-33		-57	-29
Hincesti	13.8	-30	-28	-26	-70	-49	-35		-60	-31
Ialoveni	13.5	-37	-35	-33	-88	-61	-43		-76	-37
Nisporeni	14.9	-17	-16	-18	-45	-35	-27	-90	-45	-21
Orhei	14.5	-29	-28	-27	-68	-47	-32		-58	-30
Rezina	12.7	-21	-19	-19	-44	-33	-26	-80	-38	-22
Straseni	12.7	-23	-21	-20	-51	-37	-27	-92	-44	-23
Soldanesti	14.0	-10	-9	-9	-25	-16	-15	-48	-26	-15
Telenesti	13.8	-28	-26	-25	-67	-45	-31		-59	-27
Ungheni	16.5	-12	-11	-12	-29	-20	-18	-53	-28	-16
Southern AEZ										
Basarabeasca	12.4	-36	-37	-31	-87	-60	-42		-76	-37
Cahul	11.3	-17	-16	-15	-31	-21	-15	-57	-23	-11
Cantemir	13.6	-9	-10	-9	-21	-15	-11	-43	-18	-8
Causeni	12.9	-25	-24	-22	-57	-40	-30		-49	-24
Cimislia	13.4	-36	-36	-31	-86	-59	-42		-75	-35
Leova	12.7	-17	-19	-15	-43	-30	-20	-80	-37	-16
Stefan Voda	13.5	-19	-20	-17	-47	-31	-23	-85	-40	-20
Taraclia	10.5	-16	-15	-14	-28	-17	-13	-49	-19	-8
ATU Gagauzia	10.4	-12	-14	-8	-30	-20	-14	-62	-28	-10

5.4.1.4. Projections of Future Changes in Sugar Beet Yield

According to projections, without application of adaptation measures, the most vulnerable districts for sugar beet cultivation will be Glodeni, Drochia, Falesti, Floresti, and Singerei in Northern; Telenesti, Orhei, and Rezina in Central AEZs, in which productivity of sugar beet may decrease by 2100 from 14 to 27% (RCP2.6) and/or from 65 to 87% (RCP8.5).

The least vulnerable districts for sugar beet cultivation will be Briceni and Donduseni in Northern; and Ungheni in Central AEZs, in which productivity of the sugar beet may increase by 2100 from 2 to 9% (RCP2.6) and/or from 9 to 34% (RCP8.5), in comparison with the reference period. Increase in the productivity of sugar beet is also projected for Edinet and Ocnita districts in Northern AEZ, however the yield trends in reference period (1981-2010) are statistically significant on the lowest significant level ($p \leq 0.1$), so it can be noted just a tendency to yield increase in these districts (**Table 5-42**).

Table 5-42: Projected Sugar Beet Yield Changes, (%/20 Year), under the CMIP5 Ensemble of 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the Current Situation (1981-2010)

AEZs/ district	1981-2010, q/ha	2016-2035			2046-2065			2081-2100		
		RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6
Northern AEZ										
Briceni	250.3	3	2	1	6	6	5	9	3	3
Donduseni	228.7	10	5	5	21	17	11	34	17	9
Drochia	258.9	-18	-20	-16	-47	-31	-24	-87	-45	-25
Edinet	213.9	7	1	3	11	9	5	22	12	4
Falesti	284.1	-18	-22	-16	-45	-26	-21	-87	-40	-20
Floresti	225.7	-12	-16	-11	-31	-17	-14	-65	-30	-16
Glodeni	262.9	-14	-14	-12	-38	-23	-17	-68	-34	-17
Ocnita	227.6	12	8	7	28	20	13	48	23	9
Riscani	251.0	-3	-6	-4	-13	-6	-4	-23	-10	-4

AEZs/ district	1981-2010, q/ha	2016-2035			2046-2065			2081-2100		
		RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6
Singerei	250.5	-25	-26	-24	-60	-40	-28		-52	-27
Soroca	207.1	-7	-13	-8	-20	-9	-8	-43	-19	-10
Central AEZ										
Orhei	213.1	-17	-19	-15	-36	-24	-18	-65	-30	-16
Rezina	150.1	-13	-16	-12	-34	-20	-15	-62	-29	-14
Soldanesti	176.0	1	0	0	5	4	3	10	6	2
Telenesti	183.4	-17	-18	-13	-41	-24	-19	-73	-36	-18
Ungheni	281.1	-5	-5	-5	-9	-7	-4	-18	-7	-3

5.4.1.5. Projections of Future Changes in Tobacco Yield

Without application of adaptation measures, the most vulnerable to climate change tobacco areas in the RM would be Northern, Central and to a less extent Southern AEZs. The most vulnerable districts for tobacco cultivation will be Donduseni, Briceni, Ocnita, Edinet, Soroca, Floresti, Riscani, and Glodeni in the Northern; Nisporeni, and Ungheni districts in Central; and Cimislia in Southern AEZs, in which tobacco productivity could decrease from 23 to 56% (RCP2.6) and/or from 47 to 98% (RCP4.5).

The least vulnerable districts for tobacco cultivation will be Cantemir, Leova, Taraclia and ATU Gagauzia in Southern AEZ, in which productivity of tobacco may increase by 2100 from 9 to 11% (RCP2.6) and/or from 7 to 34% (RCP8.5), in comparison with the 1981-2010 reference period.

Without adaptation measures, due to changes in climatic conditions, by the end of the XXI century the cultivation of tobacco in Donduseni, Briceni, Edinet, Soroca, Glodeni, Floresti, Ocnita, Riscani, Nisporeni, Ungheni and Cimislia districts will be either impossible according to the RCP8.5 high warming scenario, or economically not cost effective according to RCP4.5 medium warming scenarios (**Table 5-43**).

Table 5-43: Projected Tobacco Yield Changes, (%/20 Year), under the CMIP5 Ensemble of 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the Current Situation (1981-2010)

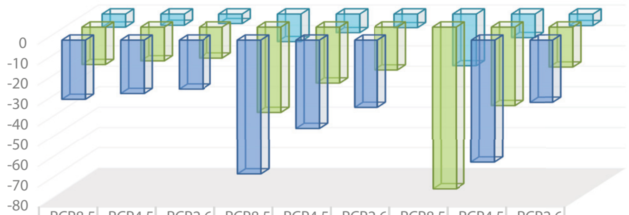
AEZs/ district	1981-2010, q/ha	2016-2035			2046-2065			2081-2100		
		RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6
Northern AEZ										
Briceni	13.0	-42	-43	-40		-72	-55		-98	-56
Donduseni	13.9	-48	-43	-41		-73	-55		-97	-56
Drochia	17.0	-15	-14	-14	-41	-28	-19	-72	-37	-18
Edinet	12.9	-21	-21	-19	-52	-36	-27	-94	-50	-27
Falesti	15.6	-15	-13	-12	-35	-24	-19	-62	-34	-20
Floresti	15.8	-31	-29	-26	-61	-45	-37		-60	-37
Glodeni	14.6	-33	-30	-30	-80	-55	-37		-72	-34
Ocnita	12.1	-41	-42	-42	-65	-53	-47	-96	-63	-48
Riscani	15.9	-28	-23	-24	-56	-41	-31	-94	-54	-30
Singerei	16.1	-10	-9	-10	-21	-15	-10	-40	-19	-9
Soroca	13.0	-33	-30	-27	-79	-57	-42		-77	-43
Central AEZ										
Criuleni	15.3	-4	-4	-7	-7	-10	-7	-11	-6	-6
Dubasari	14.6	-12	-8	-8	-27	-19	-12	-52	-24	-10
Hincesti	14.7	-11	-9	-8	-33	-19	-14	-62	-31	-15
Ialoveni	14.5	-3	-3	-5	-8	-7	-3	-14	-6	-1
Nisporeni	12.6	-28	-26	-24	-69	-46	-34		-64	-33
Orhei	14.1	-2	-2	-3	-6	-4	-3	-8	-4	-5
Rezina	12.7	-1	-2	-4	-9	-7	-2	-14	-7	-2
Soldanesti	11.6	-18	-16	-16	-39	-28	-22	-68	-33	-20
Telenesti	14.3	-11	-10	-10	-25	-18	-12	-45	-21	-11
Ungheni	15.3	-20	-18	-17	-51	-34	-24	-95	-47	-23
Southern AEZ										
Cantemir	12.7	8	8	8	20	13	11	34	20	11
Causeni	10.2	-12	-8	-14	-32	-15	-16	-42	-21	-16
Cimislia	12.6	-28	-29	-23	-65	-49	-35		-63	-36
Leova	13.7	1	0	1	6	-1	0	7	-1	0
Stefan Voda	15.6	-6	-5	-8	-13	-9	-9	-16	-10	-10
Taraclia	14.9	8	5	7	16	9	10	27	14	9
ATU Gagauzia	15.1	9	7	6	18	10	8	33	16	9

5.4.2. Climate Change and Livestock Production

The possible projections in the livestock production (*milk, eggs, wool, beef, pork, mutton and poultry*), due to future climate changes in the RM, have been considered for two alternative scenarios: (1) assuming increase in summer average temperature (June, July and August) and no decrease in the future cereal crops yield – optimistic scenario (**Figures 5-65A and 5-66A**); and (2) considering increase in summer average temperature (June, July and August) and possible decrease in the yield of the main cereal crops (winter wheat and grain maize) – pessimistic scenario (**Figures 5-65B and 5-66B**).

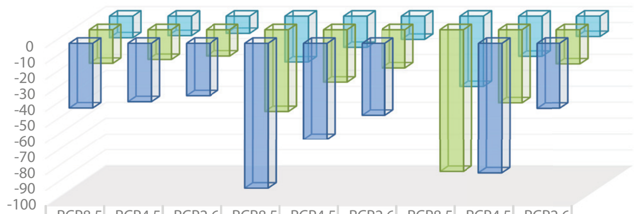
5.4.2.1. Projections of Future Changes in Milk Production

The analysis of the obtained results revealed that due to the impact of the main climate and crop predictors variables in the RM, the milk production by 2035 could decrease from 24% (RCP2.6) to 29% (RCP8.5), without changes in cereal crop yield (optimistic scenario), respectively from 33% (RCP2.6) to 41% (RCP8.5), by considering projections of changes in the yield of winter wheat and grain maize (pessimistic scenario). In comparison with the 1981-2010 reference period, by 2065 the milk production may decrease depending on the assessed emission scenario, from 33% (RCP2.6) to 66% (RCP8.5) under the optimistic scenario, and respectively from 45% (RCP2.6) to 91% (RCP8.5) under the pessimistic scenario. The maximum values of milk production decrease may be reached by 2100. Due to changes in values of main climate predictors (T_{Jun}, T_{Jul} T_{Aug} and cereal crop yield) the milk production will decrease from 30% (RCP2.6) to 60% (RCP4.5) under optimistic scenario (**Figure 5-65A**), respectively from 41% (RCP2.6) to 82% (RCP4.5) according to the pessimistic scenario (**Figure 5-65B**).



(A)

	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6
	2016-2035			2046-2065			2081-2100		
Milk	-29	-26	-24	-66	-43	-33		-60	-30
Eggs	-18	-17	-15	-42	-27	-21	-79	-38	-20
Wool	-6	-5	-5	-13	-9	-7	-25	-12	-6



(B)

	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6	RCP8.5	RCP4.5	RCP2.6
	2016-2035			2046-2065			2081-2100		
Milk	-41	-37	-33	-91	-60	-45		-82	-41
Eggs	-21	-19	-17	-51	-33	-24	-89	-46	-22
Wool	-14	-12	-11	-29	-20	-15	-44	-25	-13

Figure 5-65: Projections of future changes in livestock production (milk, eggs and wool) in the RM (%/20 years) as compared to 1981-2010 reference period, according to an ensemble from CMIP5 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6 in the XXI century: (A) Optimistic scenario – without changes in the yield of main cereal crops (winter wheat and grain maize); (B) Pessimistic scenario – considering projections of changes in the yield of main cereal crops.

5.4.2.2. Projections of Future Changes in Eggs Production

Due to the impact of main climate and crop predictor's variables in the RM, the eggs production by 2035 could decrease from 15% (RCP2.6) to 18% (RCP8.5), under the optimistic scenario, respectively from 17% (RCP2.6) to 21% (RCP8.5), according to the pessimistic scenario.

In comparison with the 1981-2010 reference period, by 2065 the eggs production may decrease from 21% (RCP2.6) to 42% (RCP8.5) under the optimistic scenario, respectively from 24% (RCP2.6) to 51% (RCP8.5) according to pessimistic scenario. The maximum values of eggs production decrease could be reached by 2100, from 20% (RCP2.6) to 79% (RCP8.5) under the optimistic scenario (**Figure 5-65A**), respectively from 22% (RCP2.6) to 89% (RCP8.5) according to the pessimistic scenario (**Figure 5-65B**).

5.4.2.3. Projections of Future Changes in Wool Production

A greater frequency of drought, pasture deterioration, higher summer temperatures and an increased incidence of pests and diseases under warmer climates are likely to put further physiological stress on sheep. This stress may be alleviated, to some degree, by higher winter temperatures and lengthening of warm seasons, both of which have the potential to improve wool quality. For wool production in the RM, a slight decrease by 5-6% in the 2016-2035 period is projected under the optimistic scenario, respectively a decrease by 11-14% under the pessimistic scenario.

In comparison with the 1981-2010 reference period, by 2065 the wool production may decrease from 7% (RCP2.6) to 13% (RCP8.5) under the optimistic scenario, respectively from 15% (RCP2.6) to 29% (RCP8.5) according to the pessimistic scenario. The maximum values of wool production reduction could be reached by the 2100, from 6% (RCP2.6) to 25% (RCP8.5) under the optimistic scenario, **Figure 5-65A**, respectively from 13% (RCP2.6) to 44% (RCP8.5) according to the pessimistic scenario, **Figure 5-65B**.

5.4.2.4. Projections of Future Changes in Beef Production

For beef production in the RM by 2035, when assessing the combined effect of T_{Jun}, T_{Jul}, T_{Aug} and cereal crop yield, a decrease is expected in productivity from 45% (RCP2.6) to 55% (RCP8.5) under the optimistic scenario, respectively from 62% (RCP2.6) to 77% (RCP8.5) under the pessimistic scenario. By 2065, a decreasing trend will persist in beef production due to climate change, increase in summer average temperature and decrease in cereal crop productivity. Severe decrease in beef production, from 62% (RCP2.6) to 82% (RCP4.5) is expected under the optimistic scenario.

While according to the pessimistic scenario, i.e. by considering the projected changes in the yield of the main cereal crops, under the RCP2.6 low warming scenario the animal breeding will be economically not cost-effective, while under the RCP8.5 (high) and RCP4.5 (medium) warming scenarios, even impossible in the conditions of the RM.

The maximum values of beef production decrease may be reached by 2100, under the optimistic scenario by 57% (RCP 2.6), **Figure 5-66A**, while according to the pessimistic scenario under all three RCP scenarios the cattle breeding will be impossible in the RM, **Figure 5-66B**.

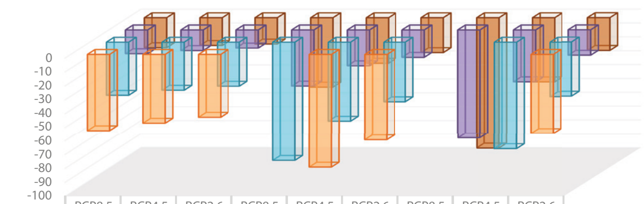
In case the predicted climate change occurs, the current beef production potential can be maintained only if supplemental feed is offered; this factor would reduce significantly the economic efficiency of cattle production and may have an impact on beef quality as well.

5.4.2.5. Projections of Future Changes in Pork Production

The climate change with rising mean temperatures may cause a permanent stress load for pigs, especially in continental summer or warmer climate areas. Due to warming and decrease in cereal crop productivity, pork production in RM by 2035 may decrease from 32% (RCP2.6) to 38% (RCP8.5) under the optimistic scenario, and respectively from 44% (RCP2.6) to 55% (RCP4.5) under the pessimistic scenario.

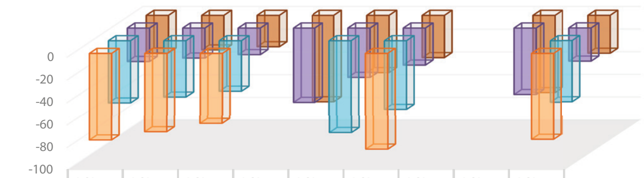
In comparison with the 1981-2010 reference period, by 2065 the pork production may decrease, depending on the assessed scenario, from 43% (RCP2.6) to 86% (RCP4.5) under the optimistic scenario, and respectively from 60% (RCP2.6) to 81% (RCP4.5) under the pessimistic scenario. The maximum values of pork production decrease may be reached by 2100, from 39% (RCP2.6) to 77% (RCP4.5) under the optimistic scenario (**Figure 5-66A**).

While according to the pessimistic scenario, i.e. by considering the projected changes in the yield of the main cereal crops, under the RCP2.6 low warming scenario the swine breeding will be economically not cost-effective, and/or even impossible in the conditions of the RM under the RCP8.5 (high) and RCP4.5 (medium) warming scenarios (**Figure 5-66B**).



(A)

	2016-2035 RCP8.5	2016-2035 RCP4.5	2016-2035 RCP2.6	2046-2065 RCP8.5	2046-2065 RCP4.5	2046-2065 RCP2.6	2081-2100 RCP8.5	2081-2100 RCP4.5	2081-2100 RCP2.6
Beef	-55	-49	-45		-82	-62			-57
Pork	-38	-34	-32	-86	-57	-43		-77	-39
Mutton	-17	-15	-13	-40	-26	-20	-78	-37	-18
Poultry	-21	-20	-19	-50	-33	-25	-94	-46	-24



(B)

	2016-2035 RCP8.5	2016-2035 RCP4.5	2016-2035 RCP2.6	2046-2065 RCP8.5	2046-2065 RCP4.5	2046-2065 RCP2.6	2081-2100 RCP8.5	2081-2100 RCP4.5	2081-2100 RCP2.6
Beef	-77	-69	-62			-85			-76
Pork	-55	-50	-44		-81	-60			-54
Mutton	-29	-26	-23	-65	-43	-33		-59	-29
Poultry	-33	-30	-28	-76	-50	-37		-68	-34

Figure 5-66: Projections of future changes in livestock production (beef, pork, mutton and poultry) in the RM (%/20 years) relative to 1981-2010 current period, according to an ensemble from CMIP5 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6 in the XXI century. (A) Optimistic scenario – without changes in the yield of main cereal crops (winter wheat and grain maize). (B) Pessimistic scenario – considering projections of changes in the yield of main cereal crops.

5.4.2.6. Projections of Future Changes in Mutton Production

For mutton production by 2035, when assessing the combined effect of T_{Jun}, T_{Aug} and cereal crop yield, a slight decrease in the productivity is expected, from 13% (RCP2.6) to 17% (RCP8.5) under the optimistic scenario, respectively from 23% (RCP2.6) to 29% (RCP8.5) under the pessimistic scenario.

In comparison with the 1981-2010 reference period by 2065, the mutton production may decrease, depending on the assessed emission scenario, from 20% (RCP2.6) to 40% (RCP8.5) under the optimistic scenario, and respectively from 33% (RCP2.6) to 65% (RCP8.5) under the pessimistic scenario.

The maximum values of mutton production decrease may be reached by 2100. Due to changes in values of main climate predictors (T_{Jun}, T_{Aug} and reduced yield of the main cereal crops), the mutton production could decrease from 18% (RCP2.6) to 78% (RCP8.5) under the optimistic scenario (**Figure 5-66A**), and respectively from 29% (RCP2.6) to 59% (RCP4.5) according to the pessimistic scenario (**Figure 5-66B**).

5.4.2.7. Projections of Future Changes in Poultry Production

The analysis of the obtained results revealed that due to the impact of the main climate (T_{Jun}, T_{Jul}) and crop yield predictors variables in the RM, the poultry production by 2035 could decrease from 19% (RCP2.6) to 21% (RCP8.5) under the optimistic scenario, respectively from 28% (RCP2.6) to 33% (RCP8.5) under the pessimistic scenario.

In comparison with the 1981-2010 reference period, by 2065 the poultry production may decrease depending on the assessed emission scenario from 25% (RCP2.6) to 50% (RCP8.5) under the optimistic scenario, respectively from 37% (RCP2.6) to 76% (RCP8.5) under the pessimistic scenario.

The maximum values of poultry production decrease could be reached by 2100. Due to changes in values of main climate predictors (T_{Jun}, T_{Jul}, T_{Aug}) and reduced yield of the main cereal crops, the poultry production will decrease from 24% (RCP2.6) to 94% (RCP8.5) under the optimistic scenario, **Figure 5-66A**, and respectively from 34% (RCP2.6) to 68% (RCP4.5) under the pessimistic scenario, **Figure 5-66B**.

Furthermore, according to the pessimistic scenario, i.e. by considering the projected changes in the yield of the main cereal crops, under the RCP4.5 (medium) warming scenario the poultry breeding will be economically not cost-effective, while under the RCP8.5 (high) warming scenarios, even impossible in the conditions of the RM.

5.4.3. Climate Change and Water Resources

5.4.3.1. Data, Methods and Summary of Observed Trends

As a methodology for calculating the average annual runoff forecast in the RM, the water balance method was used, as represented by the equation:

$$\overline{Y} = \overline{X} - \overline{E}$$

Where, $\overline{X}$ and $\overline{E}$ - mean annual aggregated values of precipitation and evaporation, mm. The formula is convincing for regional rivers with a specific nature or conditioned by climatic factors under complete drainage of groundwater.

For determining $\overline{X}$, observation data of the meteorological and hydrological monitoring network were used. Mean multiannual precipitation and monthly and annual mean temperatures were used from the database of the Meteorology Directorate of the State Hydrometeorological Service (SHS), as processed in the form of numerical models with a 250 meters resolution. The evaporation value is determined as a rule by calculation using formulas and nomograms, which are based on correlations between various hydro-meteorological features. For determining the evaporation, the model below was used:

- Mezentev model (1976):

$$\overline{E}_{zon} = \overline{E}_m \left[1 + \left(\frac{\overline{E}_m}{\overline{X}}\right)^n\right]^{-\frac{1}{3}}$$

Where, $\overline{E}_{zon}$ - multiannual mean amount of evaporation from the surface of the catchment area, mm; $\overline{X}$ - mean annual sum of precipitation, mm; $\overline{E}_m$ - maximum possible evaporation, mm, n – numeric indicator equal to 3.

In this model there are several solutions for determining the maximum possible evaporation:

- Tiurk model (1958):

$$\overline{E}_m = 300 + 25\overline{t} + 0.05\overline{t}^3$$

Where, $\overline{E}_m$ – mean multiannual temperature.

In this case, comparison of calculated evaporation with the observed one is satisfactory. However, it is worth mentioning the when determining , the data from zones with continental climate were not used (Cazac, Lalikin, 2005). The values are underestimated since mean annual temperature does not describe the temperature regime of the warm period of the year when evaporation is maximal.

- Loboda model (2003):

$$\overline{E}_m = 13.5\sum_{V}^{IX}\overline{t} - 305$$

While Tiurk model provides underestimated values, Loboda model, on the contrary, provides overestimated evaporation data.

- Gopcenco model (2001), provides the best data:

$$\overline{E}_m = 13.3\sum_{V}^{IX}\overline{t} - 307$$

This formula was developed for the territory of Ukraine, where the climatic conditions are similar to those in Moldova and the thermal regime is largely dictated by the flow of sunlight towards the earth surface.

The calculations were made based on numerical models of the catchment areas of Dniester, Prut rivers and the Dniester-Prut inter-fluvial area cut from the numerical model.

The results are shown in **Figure 5-67**.

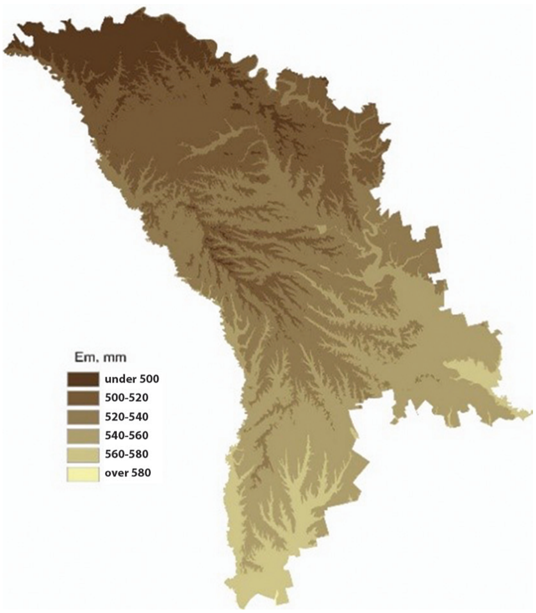


Figure 5-67: Maximally possible for the base period, 1981-2010.

The water balance equation for the zonal mean annual runoff forecast based on main climatic indices is as follows:

$$\overline{Y}_{pr} = (\overline{X} \mp \Delta\overline{X}) - \frac{(\overline{X} \mp \Delta\overline{X})}{\sqrt[4]{1 + \frac{(\overline{X} \mp \Delta\overline{X})^4}{\left[\left(1 + \frac{\varepsilon\Delta\overline{t}}{100}\right)\overline{E}_m\right]^4}}}$$

In order to calculate the contemporary annual runoff, the Mezentev (1976) water balance formula (model) is widely used. As amended by Cazac, Lalikin (2005), this model is as follows:

$$\overline{Y}_{pr} = (\overline{X} \mp \Delta\overline{X}) - \overline{E}_m(1 + \varepsilon_2\Delta\overline{t})\left\{1 + \left[\frac{\overline{E}_m(1 + \varepsilon_2\Delta\overline{t})}{(\overline{X} \mp \Delta\overline{X})}\right]^n\right\}^{-\frac{1}{n}}$$

Where, $\overline{Y}_{pr}$ - projected value of the average annual runoff, mm; and – contemporary values of maximally possible annual precipitation and evaporation, mm; and – average projected changes of annual sums of precipitation and air temperatures; - coefficient, which represents in a relative manner the changes in the maximally possible evaporation at 1°C increase in annual air temperature and it equals 0.04, according to Budico (1980); n - parameter equal to 3. For analysis of distribution of mean annual precipitation, the annual precipitation map was developed for period 1981-2010, **Figure 5-68**.

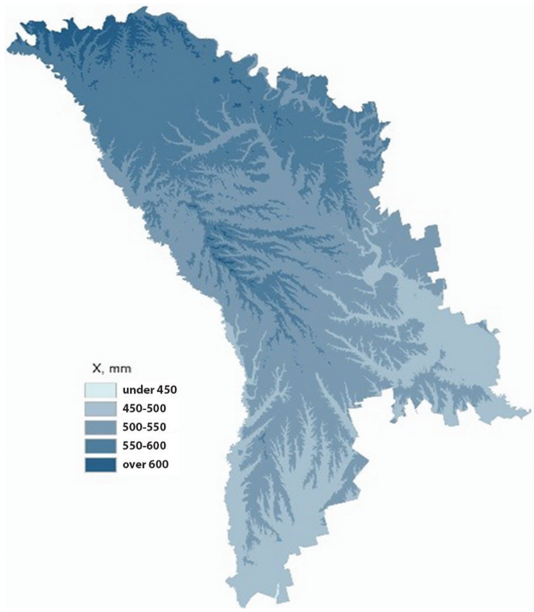


Figure 5-68: Mean annual precipitation for the base period, 1981-2010, mm.

The contemporary climate runoff was calculated using the model proposed by Professor Lalikin, 2005, **Figure 5-69**:

$$\overline{Y}_{pr} = \overline{X} - \overline{E}_m\left\{1 + \left[\frac{\overline{E}_m}{(\overline{X})}\right]^n\right\}^{-\frac{1}{n}}$$

Variables $\Delta\overline{X}$ and $\Delta\overline{t}$ were used for the three general climatic scenarios, as generated by Taranu et al. (2015).

After the center of each catchment area was found, the mean multiannual flow layer was found for each area, using the data of the State Hydrometeorological Service. The flow layer was mapped by interpolation method in conditions when mapping was carried out for the center of the basin, the place where the flow is formed, not for the closing section, where the hydrometric station is located (**Figure 5-69**).

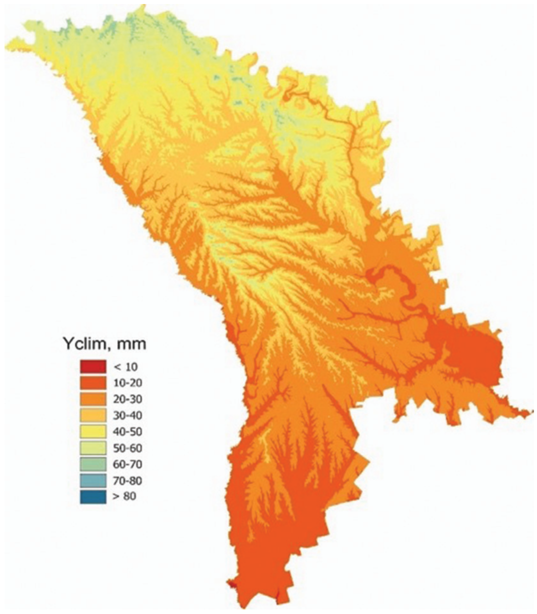


Figure 5-69: Contemporary mean climatic flow, mm.

When analyzing and comparing contemporary flow with the climatic flow, we notice that the measured flow layer is, in some cases, higher than the climate flow layer, **Figures 5-69** and **5-70**.

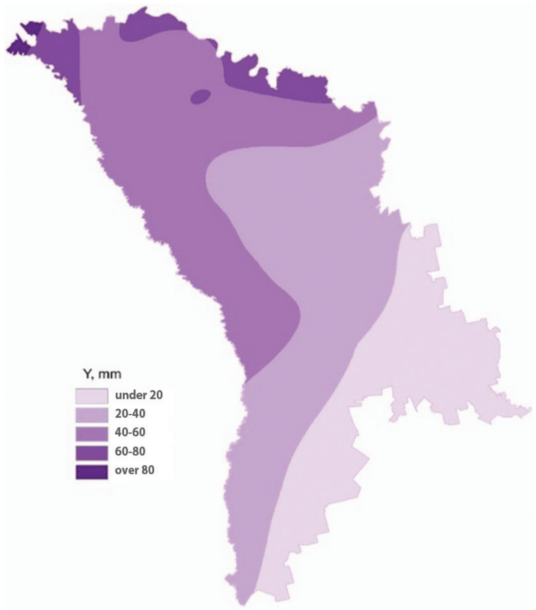


Figure 5-70: Layer of the mean multiannual flow for base period 1981-2010, mm.

The reason for this is the non-zonal nature of the rivers in the studied territory. However, comparing the climate flow layer with the measured one shows a high degree of correlation $R^2 = 0.89$, *p*-value 0.0000, **Figure 5-71**.

The high level of correlation between mean climatic flow and the mean measured flow conveys a high degree of optimism in forecasting future water flow determination based on models of climate change scenarios. The comparative analysis of mean climatic flow values shows that both now and in the future, it increases from southeast to northwest within the studied territory.

The difference showing a decrease of mean climatic flow values, as opposed to the measured ones, shows that there is need for an additional study to identify the non-zonal nature of the flow in the studied area.

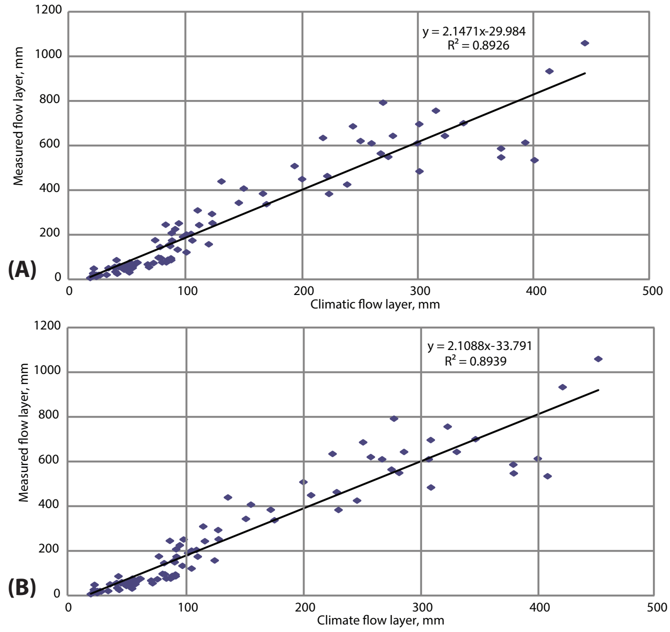


Figure 5-71: Correlation of the measured flow layer with the climatic flow layer according to models of Loboda (A) and Gopcenco (B), mm.

5.4.3.2. Projection of Future Changes in Annual Runoff/ Flow

In the conducted study, calculations and mapping results are displayed on average annual water runoff in the RM induced by climate change for three future time periods: years 2035 (2016-2035), 2065 (2046-2065) and 2100 (from 2081 to 2100), projected according to an ensemble from CMIP5 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, relative to the base period, 1981 to 2010, for three AEZs of the Republic of Moldova (Northern, Central, and Southern), **Figure 5-72, Table 5-44**.

Table 5-44: Projected Changes in the Layer of Mean Annual Flow, (%), According to an Ensemble from CMIP5 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the Base Period, 1981 to 2010, for three AEZs of the Republic of Moldova

Period	Scenarios	Northern AEZ	Central AEZ	Southern AEZ	RM
2016-2035	RCP2.6	21.5	7.4	1.9	14.7
	RCP4.5	9.6	-2.3	-7.8	3.8
	RCP8.5	15.6	3.3	0.4	9.9
2046-2065	RCP2.6	19.7	2.2	3.9	12.3
	RCP4.5	5.8	1.2	-11.1	2.4
	RCP8.5	3.4	-13.8	-22.3	-5.2
2081-2100	RCP2.6	23.5	17.0	8.1	19.7
	RCP4.5	13.2	-6.0	-18.4	3.2
	RCP8.5	-45.0	-54.8	-64.5	-50.5

Upon modelling of the climatic flow layer for the base period, it is found that its mean value for the entire country is 32.04 mm, the minimum - 9.33 mm and maximum - 70.82 mm. The Northern AEZ shows a mean climate annual flow of 42.18 mm, maximum - 70.82 mm and minimum - 21.29 mm.

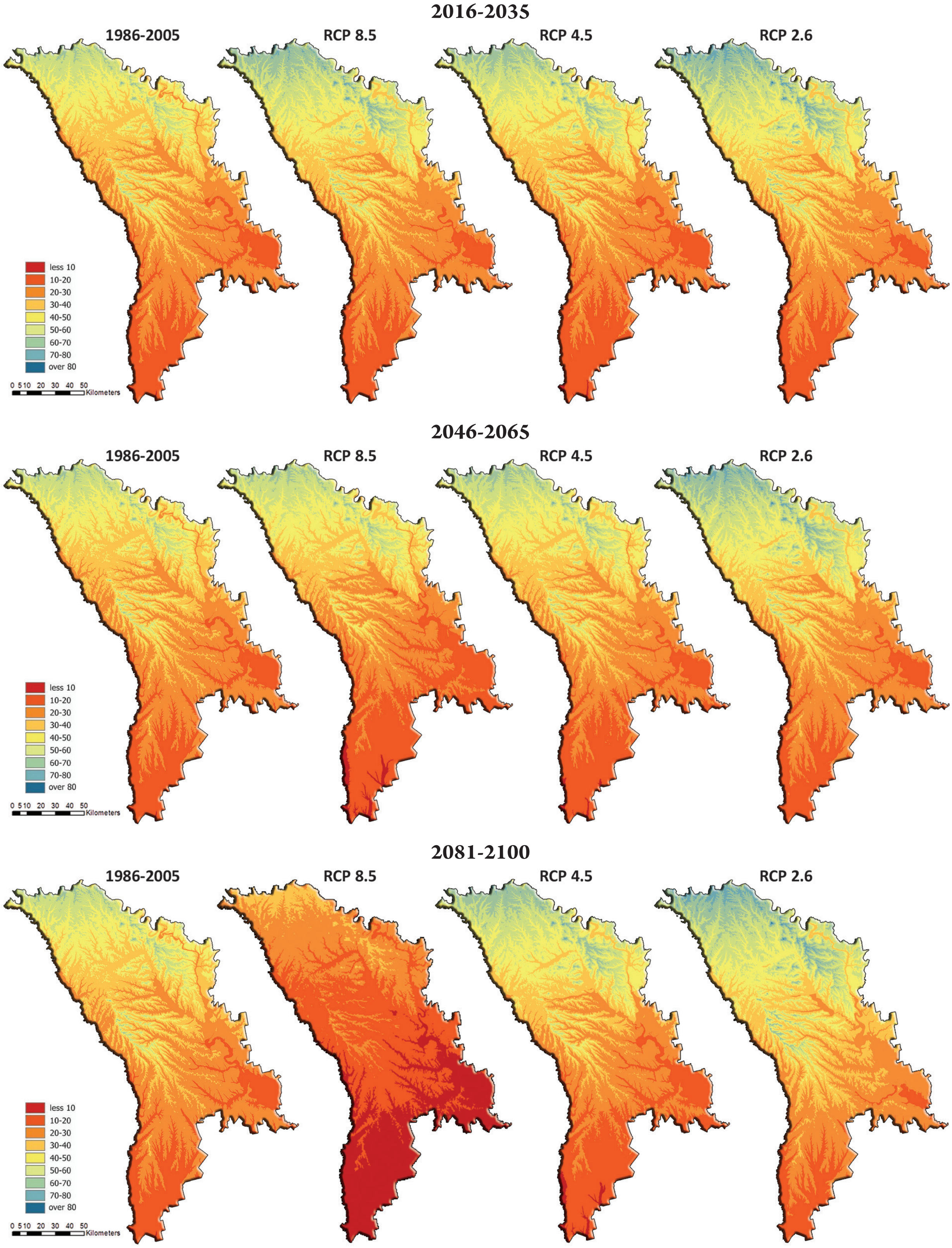


Figure 5-72: Projected CMIP5 of 21 Multi-Model Ensemble Annual Runoff / Flow, mm Development over the RM's AEZs.

The Central AEZ shows a flow of 27.61 mm as mean value, while the maximum is - 66.96 mm, and the minimum - 13.16 mm. The Southern AEZ shows values of 16.56 mm, 36.41 mm and 9.33 mm, respectively. These values are sufficient to ensure the contemporary hydrological regime of small rivers in the Republic of Moldova, but the distribution of the flow throughout the year shows, especially in the summer (due to frequent droughts), a flow, which is well below the norm, which most likely will lead to drying up of rivers, especially in the south of the country.

According to the results obtained for the years 2100, projections of climate models ensemble assessed for RCP8.5 scenario envisage a dramatic reduction in mean annual flow layer, as compared to the base period of about 45.0% in Northern AEZ, 54.8% in Central AEZ and 64.5% in Southern

AEZ; while, the climate models ensemble within RCP2.6 scenario is much more optimistic, ranging from an increase in mean annual flow layer of about 8.1% in Southern AEZ up to 23.5% in Northern AEZ.

5.4.4. Climate Change and Forestry Fire Risk Assessment

5.4.4.1. Data, Methods and Summary of Observed Trends

Forest fire is one of the most dangerous natural hazards around the world. It does not only alter forest structure but also affect the forest carbon sink and the amount of greenhouse gases and aerosols. 'Fire weather' which refers to meteorological factors is conducive to forest fire, such as precipitation, air temperature, relative humidity, and wind speed (Pausas, 2004; Westerling, 2006).

It should also be noted that prediction of forest fire occurrence is a complex issue concerning weather, tree species, geography conditions and human activities. Non-meteorological factors may also play a considerable role in fire occurrence. For instance, fire spread may be influenced by topography, forest vegetation (distribution of fuel), and ignition rates by humans (Pyne, 1996; Conedera, 2000).

Among the non-climatic factors, human activities in particular raise the probability of fire occurrence. These include human demographic patterns and activities, especially land use and fire management (Chuvieco, 2008; Zumbrunnen, 2012). Humans can also indirectly promote or restrain fires, e.g., by modifying landscape patterns, forest composition or fuel amounts. Substantial changes in fire frequency have also been found to be linked to changes in human population density, (Wallenius, 2004).

One of the simplest drought indexes used in the fire risk assessment is the Swedish Angstrom Index (Willis et al. 2001). The index is based on the statistical relationships between the reported number of fire events and several antecedent-weather-related data. A weather-based index can only predict an area-averaged risk of fire, because the only input is obtained from the point measurements at a weather station (Onderka and Melicherčík 2009). The Angstrom Index is calculated according to the following equation (Skvarenina et al. 2003):

$$I = \frac{R}{20} + \left(\frac{27 - t}{10}\right)$$

where R is daily average relative humidity (%), and t is daily average air temperature (°C). As can be seen from the equation above, I decreases along with the relative humidity and increases along with the air temperature. A reduced index indicates a higher risk of fire.

The values for **I** translate into fire risk as follow:

1. I>4.0 fire occurrence unlikely
2. 4.0<I<3.0 fire occurrence unfavorable
3. 3.0<I<2.5 fire conditions favorable
4. 2.5<I<2.0 fire conditions more favorable
5. I<2.0 fire occurrence very likely

In the RM on the average for 1966-2015 years the Angstrom index, (I) during the warm period ranged between 4.3-4.6 in April and 3.0-3.7 in July, and August, registers the values characteristic of fire occurrence unlikely in the former case and of fire occurrence unfavorable I=4.0<I<3.0 and fire conditions favorable I=3.0<I<2.5 in the latter case. The assessment of Angstrom index has shown that the risk of fire in summer will become more pronounced. According to the Angstrom index, in the 1966-2015 years the fire conditions were favorable (I= 3.0<I<2.5) for the July (Comrat), and August (Comrat, and Chisinau). The values of index near the favorable ranging 3.1-3.2 for this period were registered in Leova, Dubasari, Baltata, Falesti and Cahul, **Table 5-45**.

Table 5-45: The Monthly Averaged Angstrom Index, (I), for 1966–2015 years

Station	Warm period of year					
	IV	V	VI	VII	VIII	IX
Briceni	4.6	3.9	3.8	3.7	3.7	4.4
Soroca	4.4	3.7	3.6	3.5	3.4	4.1
Camenca	4.3	3.6	3.6	3.4	3.4	4.0
Ribnita	4.3	3.6	3.5	3.3	3.3	4.0
Balti	4.3	3.7	3.5	3.4	3.4	4.1
Bravicea	4.3	3.6	3.5	3.4	3.4	4.1
Dubasari	4.3	3.6	3.4	3.2	3.2	3.9
Baltata	4.3	3.6	3.4	3.2	3.2	3.9
Leova	4.3	3.6	3.4	3.2	3.1	3.8
Falesti	4.2	3.5	3.4	3.3	3.2	3.9
Cornesti	4.4	3.7	3.6	3.5	3.4	4.1
Chisinau	4.3	3.5	3.3	3.1	3.0	3.8
Comrat	4.3	3.6	3.4	3.0	3.0	3.8
Cahul	4.4	3.7	3.4	3.1	3.1	3.8

The values of the *CLTS* index of Angstrom index, on average for 1966-2015, for the July throughout the territory of the RM were statistically significant; they had a negative sign and varied from -0.15/10 years to 0.20/10 years, while R^2 varied from 19% to 30%, showing an increase in the risk of forest fire occurrence in the region for the summer season. The value of the determination factor, $R,^2$ of 23-38%, was higher for the August with the same *CLTS* from -0.15/10 years to 0.21/10 years, which shows a higher statistical significance of the conclusions on changes towards the risk of forest fire occurrence in the region for the summer season on the territory of the RM, especially during the July and August, **Table 5-46.**

5.4.4.2. Projection of Future Changes in Forest Fire Risk, by Angstrom Index

The meteorological data and fire statistics provided by the Republic of Moldova State Hydrometeorological Service and National Statistical data of fire occurrence were used to calculate the Forest Fire Angstrom index, along with deficit or surplus of precipitation.

In order to estimate the possible changes in forest fire risk conditions, the Angstrom index, (I) projections were modelled for two future 30-year periods, 2021-2050, and 2071-2100, according to the ensemble of EURO-CORDEX RCMs for Representative Concentration Pathways RCP8.5 and RCP4.5 in the 21st century.

Table 5-46: The Angstrom Index, (I), Trend Slope (/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value* for 1966-2015

Station	July				August			
	I	*Trend*	*R^2*	*p-value*	*I*	*Trend*	*R^2*	*p-value*
Briceni	3.7	-0.16	28	**0.0000**	3.7	-0.16	29	**0.0000**
Soroca	3.5	-0.18	30	**0.0000**	3.4	-0.20	36	**0.0000**
Camenca	3.4	-0.15	22	**0.0006**	3.4	-0.18	33	**0.0000**
Ribnita	3.3	-0.17	25	**0.0002**	3.3	-0.17	27	**0.0000**
Balti	3.4	-0.15	23	**0.0004**	3.3	-0.15	25	**0.0002**
Bravicea	3.4	-0.17	29	**0.0000**	3.4	-0.19	38	**0.0000**
Dubasari	3.2	-0.19	29	**0.0000**	3.2	-0.19	35	**0.0000**
Baltata	3.2	-0.15	19	**0.0014**	3.2	-0.15	23	**0.0005**
Leova	3.2	-0.18	27	**0.0001**	3.1	-0.17	26	**0.0002**
Falesti	3.3	-0.20	29	**0.0000**	3.2	-0.19	29	**0.0000**
Cornesti	3.5	-0.17	23	**0.0004**	3.4	-0.19	29	**0.0000**
Chisinau	3.1	-0.17	27	**0.0001**	3.0	-0.19	34	**0.0000**
Comrat	3.0	-0.18	29	**0.0000**	3.0	-0.21	35	**0.0000**
Cahul	3.1	-0.16	22	**0.0006**	3.1	-0.19	28	**0.0000**

A set of maps for better spatial and temporal visualization of the forest fire risk throughout the RM over the 1971-2000 base period, and 30-year periods, 2021-2050, and 2071-2100, according to the ensemble of EURO-CORDEX RCMs for RCP8.5 and RCP4.5 scenarios was developed. A significant correlation between meteorological parameters and forest fire occurrence was found, which opens a possibility for further investigation and analysis of geophysical and anthropogenic driven factors that can influence disaster occurrence.

In the 2021-2050 time period, according to the ensemble of EURO-CORDEX RCMs for both scenarios, over the warm period of the year, forest fire risk conditions described as "fire favorable conditions" (*I = 3.0<I<2.5*) is expected, and "more favorable fire conditions" (A = 2.5<I<2.0), depending on the scenario of greenhouse gas emissions, the I index in both scenarios will vary from 3.6 to 2.5 (July) and 3.3 to 2.3 (August), while in the 1971-2000 base period, the values of the Angstrom index in summer are within the limits when the conditions for the occurrence of fires are unfavorable (I = 4.0 < I <3.0).

In July, according to the I index, more favorable conditions for forest fires are expected in Leova, Comrat and Cahul (South AEZ), while in Briceni, Soroca and Camenca (Northern AEZ) the conditions for the fire occurrence will be unfavorable.

In August, more favorable conditions for the occurrence of forest fires are possible in Leova, Comrat and Cahul (Southern AEZ), as well as in Dubasari, Balti and Chisinau (Central AEZ) and only in Briceni the conditions for the occurrence of fires will be unfavorable, **Figure 5-73; Figure 5-74; Table 5-47;** and **Table 5-48**.

Table 5-47: The Projections of the Angstrom Index, I, for the Warm Period of the Year (July and August), According to the Ensemble of EURO-CORDEX RCMs for Representative Concentration Pathways RCP8.5 and RCP4.5

Station	1971-2000		2021-2050				2071-2100			
	July	*August*	*July*		*August*		*July*		*August*	
			RCP8.5	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*
Briceni	3.9	3.9	3.5	3.6	3.2	3.3	3.1	3.5	2.7	3.1
Soroca	3.7	3.6	3.3	3.3	2.9	2.9	2.7	3.2	2.4	2.7
Camenca	3.6	3.5	3.1	3.0	2.8	2.7	2.5	2.9	2.2	2.5
Ribnita	3.5	3.4	2.9	2.9	2.6	2.6	2.2	2.8	2.0	2.4
Balti	3.5	3.5	2.9	2.9	2.6	2.7	2.4	2.8	2.1	2.4
Bravicea	3.5	3.5	2.9	2.9	2.6	2.6	2.3	3.3	2.0	2.9
Dubasari	3.4	3.3	2.6	2.7	2.5	2.4	2.1	2.5	1.9	2.2
Baltata	3.4	3.3	2.7	2.7	2.4	2.4	2.2	2.6	1.9	2.2
Leova	3.3	3.2	2.5	2.6	2.4	2.3	2.0	2.4	1.8	2.1
Falesti	3.5	3.3	3.0	3.0	2.7	2.7	2.4	2.8	2.1	2.4
Cornesti	3.7	3.5	3.2	3.2	2.8	2.8	2.8	3.1	2.4	2.6
Chisinau	3.2	3.2	2.7	2.8	2.5	2.5	2.3	2.6	2.0	2.3
Comrat	3.2	3.2	2.5	2.5	2.3	2.3	2.0	2.3	1.8	2.1
Cahul	3.2	3.2	2.5	2.6	2.3	2.3	2.1	2.4	2.0	2.1

Table 5-48: The Possible Projections of the Change in the Angstrom Index, According to the Ensemble of EURO-CORDEX RCMs for Representative Concentration Pathways RCP8.5 and RCP4.5 in 2021-2050

Station	Warm Period of Year											
	IV		V		VI		VII		VIII		IX	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
Briceni	**4.9**	**5.0**	**4.4**	**4.5**	**4.0**	**4.1**	**3.5**	**3.6**	**3.2**	**3.3**	**3.9**	**4.0**
Soroca	**4.7**	**4.7**	**4.3**	**4.3**	**3.9**	**3.8**	**3.3**	**3.3**	**2.9**	**2.9**	**3.7**	**3.7**
Camenca	**4.8**	**4.7**	**4.3**	**4.2**	**3.8**	**3.6**	**3.1**	**3.0**	**2.8**	**2.7**	**3.6**	**3.5**
Ribnita	**4.7**	**4.7**	**4.1**	**4.1**	**3.6**	**3.6**	**2.9**	**2.9**	**2.6**	**2.6**	**3.4**	**3.4**
Balti	**4.5**	**4.6**	**4.0**	**4.0**	**3.5**	**3.5**	**2.9**	**2.9**	**2.6**	**2.7**	**3.4**	**3.5**
Bravicea	**4.5**	**4.5**	**4.0**	**4.1**	**3.5**	**3.5**	**2.9**	**2.9**	**2.6**	**2.6**	**3.4**	**3.4**

Station	Warm Period of Year											
	IV		V		VI		VII		VIII		IX	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
Dubasari	4.6	4.6	4.0	4.0	3.4	3.4	2.6	2.7	2.5	2.4	3.3	3.3
Baltata	4.6	4.6	4.0	4.0	3.5	3.4	2.7	2.7	2.4	2.4	3.3	3.3
Leova	4.5	4.5	3.8	3.9	3.2	3.2	2.5	2.6	2.4	2.3	3.2	3.3
Falesti	4.6	4.6	4.1	4.1	3.6	3.5	3.0	3.0	2.7	2.7	3.5	3.5
Cornesti	4.7	4.7	4.2	4.3	3.8	3.7	3.2	3.2	2.8	2.8	3.6	3.6
Chisinau	4.6	4.6	4.0	4.1	3.5	3.4	2.7	2.8	2.5	2.5	3.3	3.4
Comrat	4.6	4.5	3.9	3.9	3.3	3.2	2.5	2.5	2.3	2.3	3.2	3.2
Cahul	4.6	4.5	4.0	4.0	3.4	3.3	2.5	2.6	2.3	2.3	3.2	3.2

In the 2071-2100 years the tendency to the growth of forest fire risk conditions of the warm period (July, and August) will be maintained, and will be much higher for the RCP8.5 scenario, furthermore the fire risk meteorological conditions will be possible from June in Ribnita, Dubasari, Baltata, Leova, Comrat and Cahul and will continue until September, capturing almost the entire territory of the Republic of Moldova, with the exception of Briceni, Soroca, Camenca, Bravicea, and Cornesti, **Table 5-49**.

In July, according to the scenario of RCP8.5, more favorable conditions for forest fires occurrence are expected in Ribnita, Balti, Falesti (Northern AEZ), Bravicea, Dubasari, Baltata and Chisinau (Central AEZ), Leova, Comrat and Cahul (South AEZ) and only in Briceni conditions for the occurrence of forest fires will be unfavorable, **Figure 5-73**, **Table 5-49**.

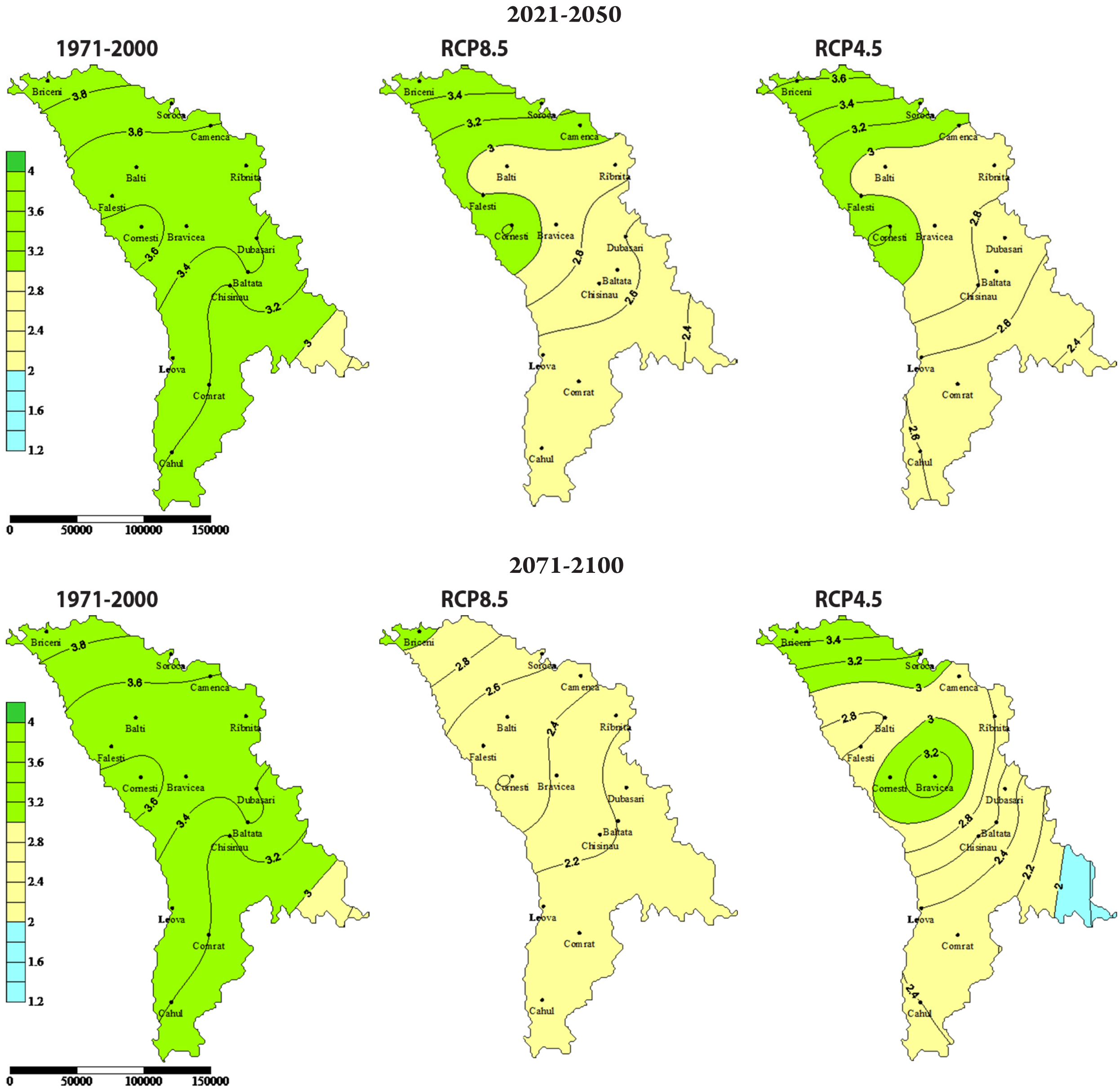


Figure 5-73: Projected EURO-CORDEX RCMs Ensemble Angstrom Index Development in July throughout the RM.

Table 5-49: The Possible Projections of the Change in the Angstrom Index, According to the Ensemble of EURO-CORDEX RCMs for Representative Concentration Pathways RCP8.5 and RCP4.5 in 2071-2100

Station	Warm Period of Year											
	IV		V		VI		VII		VIII		IX	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
Briceni	4.5	4.9	4.1	4.4	3.7	4.0	3.1	3.5	2.7	3.1	3.4	3.8
Soroca	4.6	4.7	4.0	4.2	3.5	3.7	2.7	3.2	2.4	2.7	3.2	3.6
Camenca	4.5	4.6	3.9	4.1	3.3	3.5	2.5	2.9	2.2	2.5	3.1	3.4
Ribnita	4.5	4.6	3.8	4.0	3.0	3.4	2.2	2.8	2.0	2.4	2.9	3.3
Balti	4.4	4.5	3.8	4.0	3.1	3.4	2.4	2.8	2.1	2.4	3.0	3.3
Bravicea	4.3	4.8	3.7	4.3	3.1	3.9	2.3	3.3	2.0	2.9	2.9	3.7
Dubasari	4.4	4.5	3.7	3.9	2.9	3.3	2.1	2.5	1.9	2.2	2.9	3.2
Baltata	4.3	4.5	3.7	3.9	3.0	3.3	2.2	2.6	1.9	2.2	2.8	3.2
Leova	4.2	4.5	3.5	3.8	2.7	3.1	2.0	2.4	1.8	2.1	2.8	3.1
Falesti	4.4	4.5	3.8	4.0	3.2	3.4	2.4	2.8	2.1	2.4	3.0	3.3
Cornesti	4.6	4.7	4.1	4.2	3.5	3.7	2.8	3.1	2.4	2.6	3.2	3.4
Chisinau	4.6	4.6	3.9	4.0	3.2	3.3	2.3	2.6	2.0	2.3	3.0	3.3
Comrat	4.3	4.5	3.6	3.8	2.7	3.0	2.0	2.3	1.8	2.1	2.7	3.1
Cahul	4.2	4.5	3.5	3.9	2.8	3.2	2.1	2.4	2.0	2.1	2.9	3.1

In August, according to the RCP8.5 scenario, the favorable and more favorable meteorological conditions for the occurrence of forest fires are possible throughout the territory of the Republic of Moldova, including Dubasari, and Baltata. For the RCP4.5 scenario, the favorable and more favorable forest fire risk meteorological conditions are expected on the most territory of the Republic of Moldova only in July and August, **Figure 5-74**, **Table 5-49**.

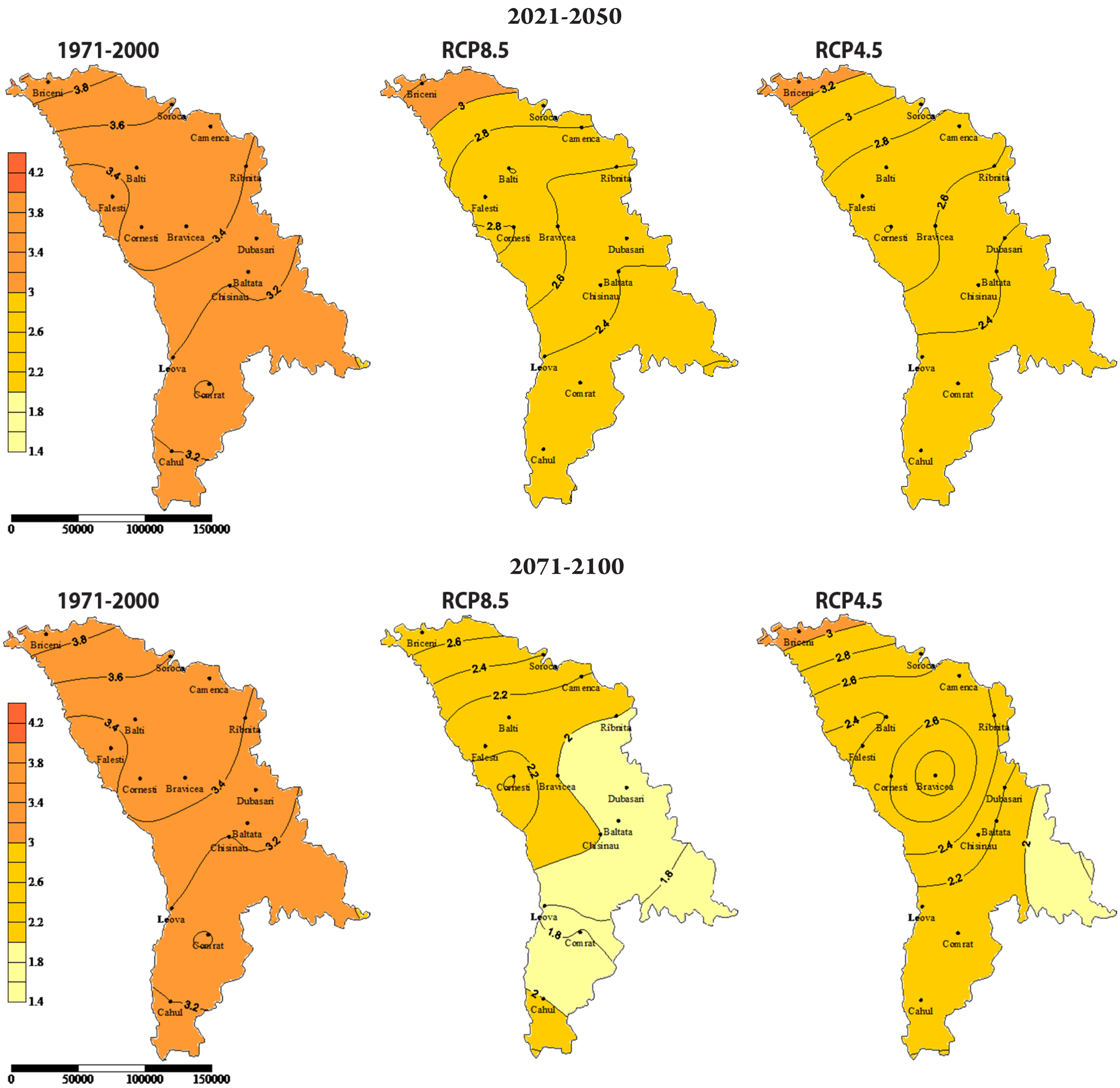


Figure 5-74: Projected EURO-CORDEX RCMs Ensemble Angstrom Index Development in August throughout the RM.

Analyzing past and predicting future fires are crucial for policy development and forest management practices to prevent and mitigate fires. The use of the indices, as a fire occurrence likelihood measure, was illustrated here in forest fire risk case study in the Republic of Moldova. The results from this study can be used for creation of the platform for fire management operational framework that can be used as a tool for decision making prevention, detection and monitoring of forest fire hazards at both the district and national levels in the Republic of Moldova. Such a programme would be in line with the forest fire risk assessment and management practices that are currently being developed internationally.

5.4.5. Potential Impacts of Climate Change on Bioclimatic Conditions

5.4.5.1. Summary of Observed Bioclimatic Trends in the RM

5.4.5.1.1. Observed Trends in Bodman Index (BI)

On the territory of the Republic of Moldova, the values of the Bodman severity index, S (1), in winter varied from 1.5 to 2.3 points, which shows that winter conditions are "mildly severe" and "moderately severe", while for S (2) the score ranges from 2.1 to 3.2 points. However, the values of the winter severity index, S (1), on the territory of the Republic of Moldova during the cold season of the year (from November to March) at the stations located in the central part of the country - Chisinau, Baltata, Bravicea, in the eastern part - Rabnita, Dubasari, Tiraspol, and in South - Comrat, were rated as "mildly severe". In the rest of the studied area, winter was described as "moderately severe" *(2<S<3)*. The harshest conditions (2.3 points) of the winter period were observed in the southwestern part of the RM - Leova, Cahul, Table 5-50.

In general, for the cold period of the year, from November to March, the average CLTS values of Bodman winter severity index, S (1), on the territory of the RM varied from -0.03 points / 10 years to -0.12 points / 10 years. The most noticeable statistically significant improvement in bioclimatic conditions in winter was observed in January: the CLTS values of the winter severity index, S (1), varied from -0.09 points / 10 years in Central AEZ to -0.12 points / 10 years in Southern AEZ, while the coefficient of determination, R^2 varied from 21% to 31%, **Table 5-51**.

The smallest statistically significant improvement in bioclimatic conditions in winter was noted in March; the CLTS values for the winter severity index, S (1), varied from -0.04 points / 10 years in Central AEZ to -0.05 points / 10 years in Northern AEZ, while the coefficient of determination, $R,^2$ varied from 4% to 11%.

During the same period, for the Bodman winter severity index, S (2), the negative CLTS values were significantly higher than those for S (1), from -0.08 points / 10 years to -0.23 points / 10 years; the coefficient of determination, R^2 having varied from 7% to 46%. This shows a higher statistical significance of the findings on changes in the severity of winters towards softer winters in all three Agro-ecological zones (AEZs) of the RM, **Table 5-52.**

Table 5-50: The Monthly Averages of the Winter Severity Index, S, (score) for 1966-2015

Stations	January		February		March		November		December	
	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)
Briceni	2.0	2.8	2.0	2.8	1.6	2.4	1.5	2.2	1.8	2.4
Soroca	2.2	3.1	2.2	3.1	1.8	2.7	1.6	2.4	2.0	2.8
Camenca	2.0	2.9	2.0	2.9	1.7	2.6	1.5	2.3	1.9	2.7
Rabnita	1.9	2.7	1.9	2.7	1.5	2.4	1.4	1.7	1.7	2.1
Balti	1.9	2.8	1.9	2.9	1.6	2.6	1.5	2.3	1.7	2.6
Bravicea	1.6	2.4	1.6	2.4	1.3	2.2	1.2	1.9	1.5	2.2
Dubasari	1.8	2.5	1.7	2.4	1.4	2.2	1.3	1.9	1.6	2.3
Tiraspol	1.9	2.8	1.9	2.8	1.6	2.5	1.4	2.2	1.7	2.5
Baltata	1.9	2.9	1.9	2.9	1.6	2.6	1.4	2.2	1.7	2.6
Leova	2.3	3.2	2.2	3.1	1.8	2.7	1.6	2.4	2.0	2.9
Falesti	1.9	2.6	1.8	2.5	1.5	2.2	1.4	1.9	1.7	2.4
Cornesti	2.0	2.8	2.0	2.8	1.6	1.9	1.5	2.2	1,8	2.6
Chisinau	1.9	2.6	1.9	2.5	1.5	2.2	1.4	2.0	1.8	2.4
Comrat	1.9	2.7	1.9	2.7	1.6	2.4	1.4	2.0	1.7	2.4
Cahul	2.3	3.2	2.2	3.2	1.8	2.8	1.6	2.4	2.1	2.9

Table 5-51: The Monthly Averages of the Bodman Winters Severity Index, S (1), (Points), Trend Slope (Points/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value* for 1966-2015

Month	Northern AEZ				Central AEZ				Southern AEZ			
	S	Trend	R^2	p-value	S	Trend	R^2	p-value	S	Trend	R^2	p-value
November	1.5	-0.06	16	**0.0052**	1.4	-0.03	3	0.1318	1.6	-0.06	9	**0.0350**
December	1.8	-0.07	17	**0.0024**	1.8	-0.02	2	0.3373	2.1	-0.04	5	0.1242
January	2.0	-0.10	31	**0.0000**	1.9	-0.09	21	**0.0013**	2.3	-0.12	23	**0.0015**
February	2.0	-0.09	18	**0.0007**	1.9	-0.06	7	**0.0238**	2.2	-0.09	14	**0.0028**
March	1.6	-0.05	11	**0.0129**	1.5	-0.03	4	**0.0989**	1.8	-0.05	8	0.0597

Table 5-52: The Monthly Averages of the Winter Severity Index, S(2), (Points), Trend Slope (Points / 10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value* for 1966-2015

Month	Northern AEZ				Central AEZ				Southern AEZ			
	S	*Trend*	*R²*	*p-value*	*S*	*Trend*	*R²*	*p-value*	*S*	*Trend*	*R²*	*p-value*
November	2.2	-0.15	30	**0.0000**	2.0	-0.04	5	0.0678	2.9	-0.09	15	**0.0062**
December	2.6	-0.17	34	**0.0000**	2.4	-0.03	2	0.3228	2.4	-0.08	9	**0.0273**
January	2.8	-0.23	46	**0.0000**	2.6	-0.13	24	**0.0005**	3.2	-0.20	36	**0.0000**
February	2.8	-0.16	26	**0.0000**	2.5	-0.07	7	**0.0339**	3.2	-0.12	18	**0.0014**
March	2.4	-0.08	16	**0.0022**	2.2	-0.05	11	**0.1572**	2.8	-0.06	8	**0.0916**

5.4.5.1.2. Observed Trends in Effective Temperature (ET)

In order to assess the degree of climate comfort, the ***Effective Temperature (ET)*** was calculated, which shows the feeling of the degree of heat or cold in the body of a half unclothed (up to the waist) person; it is an empirical function of temperature and relative air humidity. On the average for the years 1966-2015, the monthly averages of the *ET* index in January were from -3.0°C in the north (Briceni) to -1.4° C in the south of the country (Cahul), while in July they showed from +18.5°C in the north to +20.2°C in the south (Comrat), with a maximum of +20.4°C in the east (Dubasari). The analysis of the obtained data shows that on the territory of the RM during the cold period (from November to March) the *ET* index varied from -3.0°C (January) to +5.2°C (November), which describes the winter conditions in the studied area as "cold" and "moderate", with a "moderate" load on the human body. The values of the *ET* index during the warm period (from May to September) varied on the territory of the RM from +13.8°C to +15.8°C in September, to +18.5°C to +20.4°C in July, which describe the bioclimatic conditions, on the average for 1966-2015, as "moderately warm" and "warm", with a comfortable load. Throughout the territory of the RM, the thermal feeling during the warm period were described as "moderately warm" with a comfortable load and varied from +16.3 (Briceni) to +18.0 (Comrat), **Table 5-53.**

Table 5-53: The Monthly Averages of the Effective Temperature (ET) Index for 1966-2015

Stations	Cold period of the year					Warm period of the year				
	I	II	III	XI	XII	V	VI	VII	VIII	IX
Briceni	-3.0	-1.6	2.8	3.3	-1.2	14.3	16.9	18.5	17.9	13.8
Soroca	-2.5	-1.4	3.3	3.7	-0.8	14.8	17.5	19.1	18.5	14.3
Camenca	-2.5	-1.1	3.5	4.0	-0.6	15.1	17.8	19.4	18.8	14.7
Rabnita	-2.1	-0.8	3.8	4.3	-0.3	15.1	17.9	19.6	18.9	14.8
Balti	-2.1	-0.6	3.9	4.3	-0.3	15.3	18.1	19.6	19.0	14.8
Bravicea	-1.6	-0.2	4.3	4.8	0.3	15.4	18.2	19.7	19.0	14.8
Dubasari	-1.5	-0.2	4.2	4.9	0.5	15.8	18.8	20.4	19.8	15.6
Baltata	-1.5	-0.2	4.1	4.8	0.3	15.2	18.2	19.8	19.2	15.1
Leova	-2.0	-0.4	4.2	4.8	-0.2	15.3	18.1	19.8	19.4	15.5
Falesti	-2.0	-0.4	4.2	4.6	-0.1	15.4	18.1	19.6	19.2	15.2
Cornesti	-2.1	-0.6	3.9	4.4	-0.2	15.0	17.6	19.2	18.8	14.8
Chisinau	-1.5	-0.1	4.2	4.9	0.3	15.4	18.3	20.0	19.5	15.4
Comrat	-1.4	0.1	4.4	5.2	0.3	15.5	18.5	20.2	19.8	15.7
Cahul	-1.4	0.1	4.5	5.2	0.3	15.4	18.4	20.1	19.7	15.8

The CLTS values of the ET index during the cold period on the entire territory of the RM were statistically significant; had a positive sign and varied from +0.25 to +0.40°C/10 years, R^2 was from 9% to 14%, which shows an increase in the bioclimatic comfort of the weather in the region. The value of the coefficient of determination, R^2, amounting to 34-46% is significantly higher for the warm period of the year, with CLTS from +0.31 to 0.41°C/10 years, which shows a greater statistical significance of the findings on changes in bioclimatic conditions on the territory of the RM towards warming, especially during the warm period of the year, **Table 5-54**.

Table 5-54: The Effective Temperature (ET) Index, (°C), Trend Slope (°C/10 years), Coefficient of Determination, R^2, and Statistical Significance of Changes, p-value for 1966-2015

Stations	Cold period of the year				Warm period of the year			
	ET	*Trend*	*R²*	*p-value*	*ET*	*Trend*	*R²*	*p-value*
Briceni	0.1	+0.37	14	**0.0068**	16.3	+0.39	42	**0.0000**
Soroca	0.5	+0.35	13	**0.0090**	16.8	+0.34	29	**0.0000**
Camenca	0.7	+0.35	12	**0.0129**	17.2	+0.38	39	**0.0000**
Rabnita	1.0	+0.34	14	**0.0078**	17.3	+0.38	42	**0.0000**
Balti	1.0	+0.29	9	**0.0332**	17.3	+0.36	44	**0.0000**
Bravicea	1.5	+0.32	10	**0.0222**	17.4	+0.37	44	**0.0000**
Dubasari	1.6	+0.35	14	**0.0073**	18.1	+0.40	46	**0.0000**
Baltata	1.5	+0.36	14	**0.0077**	17.5	+0.31	34	**0.0000**
Leova	1.3	+0.25	8	**0.0434**	17.6	+0.33	40	**0.0000**
Falesti	1.3	+0.40	16	**0.0037**	17.5	+0.41	46	**0.0000**
Cornesti	1.1	+0.29	10	**0.0237**	17.1	+0.40	44	**0.0000**
Chisinau	1.6	+0.25	7	**0.0569**	17.7	+0.36	42	**0.0000**
Comrat	1.7	+0.26	9	**0.0331**	18.0	+0.33	41	**0.0000**
Cahul	1.8	+0.30	11	**0.0201**	17.9	+0.38	47	**0.0000**

5.4.5.1.3. *Observed Trends in Equivalent-Effective Temperature of Miserand (EET)*

In the mobile air (at $V > 0.2$ m/s), the heat transfer intensity increases, while the order of the level and the structure of the thermal feeling change. To take into account the complex effect of temperature, wind and humidity on people, the Equivalent Effective Temperature *(EET)* is used. The analysis of obtained data shows that on the territory of the RM during the cold period of the year (from November to March) the Missenard *EET* index, on the average for 1966-2015, ranged from -26.2°C (January) to -13.8°C (November), which describe the conditions of the cold period in the studied area from "frostbite threat onset", "very cold" to "cold". In January, the average monthly values of the *EET* index ranged from -26.2°C in the North (Briceni) to -23.8°C in the South of the country (Comrat), while in July it ranged from +6.9°C in the North (Briceni) to +9.5°C in the South (Comrat) with a maximum of +10.3°C in the east (Dubasari), which describe the weather conditions in winter as "very cold" (*EET* = -18°C ... -24°C) and "frostbite threat onset" (EET less than -24°C), while in summer it is "cool" (*EET = +6°C ... +12°C*), **Table 5-55.**

Table 5-55: The Equivalent-Effective Temperature Index, *EET, °C*, by Missenard, 1966-2015

Stations	Cold period of the year					Warm period of the year				
	I	II	III	XI	XII	V	VI	VII	VIII	IX
Briceni	-26.2	-24.5	-17.8	-16.5	-23.3	0.1	4.4	6.9	6.2	-0.3
Soroca	-26.2	-24.7	-17.7	-16.5	-23.3	0.4	4.8	7.6	6.9	0.0
Camenca	-25.7	-24.0	-17.2	-15.9	-22.7	1.1	5.7	8.4	7.6	1.0
Rabnita	-24.7	-23.3	-16.4	-15.0	-21.8	1.5	6.1	8.8	8.0	1.3
Balti	-24.9	-23.1	-16.6	-15.1	-21.9	1.3	5.9	8.5	7.7	1.0
Bravicea	-23.5	-21.6	-15.0	-13.6	-20.4	2.5	6.9	9.5	8.6	1.9
Dubasari	-23.7	-22.0	-15.5	-13.8	-20.5	2.8	7.6	10.3	9.4	2.8
Baltata	-24.2	-22.6	-16.3	-14.4	-21.1	1.2	6.1	8.8	8.1	1.4
Leova	-25.4	-23.3	-16.5	-14.9	-22.4	1.0	5.8	8.5	8.1	1.6
Falesti	-24.6	-22.6	-15.9	-14.6	-21.7	1.8	6.3	9.0	8.4	1.8
Cornesti	-25.0	-23.2	-16.8	-15.3	-22.1	0.9	5.4	8.1	7.4	0.9
Chisinau	-24.1	-22.4	-16.0	-14.3	-21.3	1.7	6.4	9.2	8.6	2.0
Comrat	-23.8	-22.0	-15.7	-13.8	-21.0	1.7	6.7	9.5	8.9	2.4
Cahul	-24.8	-22.9	-16.5	-14.6	-22.0	0.8	5.8	8.7	8.2	1.8

The *CLTS* values of the *EET* index for 1966-2015 over the cold period throughout the territory of the RM were statistically significant; they had a positive sign and varied from 0.40°C/10 years to 0.81°C/10 years, while R^2 varied from 8% to 28%, which shows an increase in the climatic comfort during the cold period. The *CLTS* value is significantly higher for the warm period of the year 0.57°C/10 years - 0.88°C/10 years with the coefficient of determination R^2 from 31% to 62%, which shows a greater statistical significance of the conclusions on changes in the bioclimatic conditions of the warm period of the year on the territory of the RM, **Table 5-56.**

Table 5-56: The EET by Missenard, °C, Trend Slope (points/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value* for 1966-2015

Stations	Cold period of the year				Warm period of the year			
	EET	*Trend*	R^2	*p-value*	*EET*	*Trend*	R^2	*p-value*
Briceni	-21.7	+0.68	20	**0.0008**	3.5	+0.75	45	**0.0000**
Soroca	-21.7	+0.56	15	**0.0050**	3.9	+0.61	31	**0.0000**
Camenca	-21.1	+0.60	15	**0.0004**	4.7	+0.68	44	**0.0000**
Rabnita	-20.3	+0.71	23	**0.0003**	5.1	+0.79	55	**0.0000**
Balti	-20.3	+0.60	15	**0.0060**	4.9	+0.69	50	**0.0000**
Bravicea	-18.8	+0.60	16	**0.0040**	5.9	+0.77	54	**0.0000**
Dubasari	-19.1	+0.65	21	**0.0009**	6.6	+0.76	55	**0.0000**
Baltata	-19.7	+0.63	19	**0.0015**	5.1	+0.62	46	**0.0000**
Leova	-20.5	+0.81	28	**0.0000**	5.0	+0.88	62	**0.0000**
Falesti	-19.9	+0.65	19	**0.0016**	5.5	+0.78	57	**0.0000**
Cornesti	-20.5	+0.67	21	**0.0008**	4.5	+0.83	56	**0.0000**
Chisinau	-19.6	+0.45	10	**0.0269**	5.6	+0.61	38	**0.0000**
Comrat	-19.2	+0.40	8	**0.0400**	5.8	+0.57	41	**0.0000**
Cahul	-20.2	+0.57	16	**0.0038**	5.1	+0.67	47	**0.0000**

5.4.5.1.4. *Observed Trends in Normally Equivalent Effective Temperature (NEET)*

For an analytical evaluation of the thermal feeling of a dressed person Butyeva has proposed the **Normally Equivalent-Effective Temperature (*NEET*)** index, which takes into account the influence of temperature, air humidity and wind speed. The values of the NEET index in the range from +17°C to +22°C are considered to be comfortable. The cold period of the year on the territory of the RM is described by negative values of the *NEET* index. These values are in the zone of "cold discomfort" and the irritating effect of temperatures (*NEET = -18°C ... 0°C*). The *NEET* index, on average for 1966-2015, has varied in December from -11.7°C (Briceni) to -9.8°C (Comrat), in January from -14.5°C to -12.1°C, in February from -12.6°C to -10.6°C, respectively, which has a particularly negative effect on the health of people. In May, the values of the *NEET* index increase from +7.1°C in the North (Briceni) to +8.3°C in the South (Comrat), with a maximum of +9.3°C in Dubasari, which is described as "cool" (*NEET = +6°C ... +12°C*). During the summer months, the *NEET* index in June ranges from +10.5°C (Briceni) to +12.3°C (Comrat), in August from +12.0°C to +14.1°C, in July from +12.5°C to +14.6°C, respectively, with a maximum of +15.3°C (Dubasari), which describes the bioclimatic conditions on the entire territory of the RM as "cool" and "moderately warm, comfortable" (*NEET = +12°C ... +24°C*). By the beginning of autumn, the values of *NEET* are beginning to decrease: in September the *NEET* varies from +6.7°C to +8.9°C, **Table 5-57.**

Table 5-57: The Normally Equivalent Effective Temperature Index, *NEET,* °C (1966-2015)

Stations	Cold period of the year					Warm period of the year				
	I	II	III	XI	XII	V	VI	VII	VIII	IX
Briceni	-14.0	-12.6	-7.2	-6.2	-11.7	7.1	10.5	12.5	12.0	6.7
Soroca	-14.0	-12.7	-7.2	-6.2	-11.7	7.4	10.8	13.0	12.4	7.0
Camenca	-13.6	-12.2	-6.8	-5.7	-11.2	7.9	11.6	13.7	13.0	7.8
Rabnita	-12.8	-11.6	-6.2	-5.0	-10.5	8.2	11.9	14.0	13.4	8.0
Balti	-12.9	-11.5	-6.3	-5.1	-10.5	8.0	11.7	13.8	13.1	7.8
Bravicea	-11.8	-10.3	-5.0	-3.9	-9.3	8.9	12.6	14.6	13.8	8.5
Dubasari	-12.0	-10.6	-5.5	-4.1	-9.4	9.3	13.1	15.3	14.5	9.2
Baltata	-12.3	-11.1	-6.0	-4.5	-9.9	8.0	11.9	14.1	13.5	8.1
Leova	-13.3	-11.6	-6.2	-5.0	-10.9	7.8	11.6	13.8	13.5	8.3
Falesti	-12.7	-11.1	-5.7	-4.7	-10.3	8.4	12.1	14.2	13.7	8.5
Cornesti	-13.1	-11.6	-6.4	-5.3	-10.7	7.7	11.3	13.4	12.9	7.7
Chisinau	-12.3	-10.9	-5.8	-4.4	-10.0	8.3	12.2	14.4	13.8	8.6
Comrat	-12.1	-10.6	-5.5	-4.0	-9.8	8.3	12.3	14.6	14.1	8.9
Cahul	-12.9	-11.3	-6.2	-4.7	-10.6	7.7	11.6	14.0	13.5	8.4

The *CLTS* values of the *NEET* index for 1966-2015, for the cold period, throughout the territory of the RM, were statistically significant; they had a positive sign and varied from +0.32 to +0.65°C/10 years, R^2 was from 8% to 28%, which shows an increase in the climate comfort of the region. The value of the coefficient of determination, R^2, of 38-62% was significantly higher for the warm period of the year with a *CLTS* of +0.45°C/10 years to 0.70°C/10 years, which shows a higher statistical significance of the conclusions for changes towards warming in the bioclimatic conditions of the warm period of the year on the territory of the RM, especially during the warm period of the year, **Table 5-58.**

Table 5-58: The *NEET*, °C, Trend Slope (points/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value,* 1966-2015

Stations	Cold period of the year				Warm period of the year			
	NEET	*Trend*	R^2	*p-value*	*NEET*	*Trend*	R^2	*p-value*
Briceni	-10.3	+0.54	15	**0.0009**	9.8	+0.60	45	**0.0000**
Soroca	-10.3	+0.45	15	**0.0051**	10.1	+0.48	31	**0.0000**
Camenca	-9.9	+0.48	15	**0.0049**	10.8	+0.54	44	**0.0000**
Rabnita	-9.2	+0.57	23	**0.0004**	11.1	+0.63	55	**0.0000**
Balti	-9.3	+0.47	15	**0.0060**	10.9	+0.55	50	**0.0000**
Bravicea	-8.1	+0.48	16	**0.0041**	11.7	+0.61	54	**0.0000**
Dubasari	-8.3	+0.52	21	**0.0010**	12.3	+0.60	55	**0.0000**
Baltata	-8.8	+0.51	19	**0.0015**	11.1	+0.50	46	**0.0000**
Leova	-9.4	+0.65	28	**0.0000**	11.0	+0.70	62	**0.0000**
Falesti	-8.9	+0.52	19	**0.0016**	11.4	+0.63	57	**0.0000**
Cornesti	-9.4	+0.54	22	**0.0000**	10.6	+0.66	56	**0.0000**
Chisinau	-8.7	+0.36	10	**0.0269**	11.5	+0.49	38	**0.0000**
Comrat	-8.4	+0.32	8	**0.0401**	11.7	+0.45	41	**0.0000**
Cahul	-9.1	+0.46	16	**0.0038**	11.0	+0.54	47	**0.0000**

5.4.5.1.5. Observed Trends in Radiation-Equivalent Effective Temperature (REET)

The recreational and climatic resources of the summer allow us to evaluate the index proposed by G.V. Sheleikhovsky, Radiation-Equivalent Effective Temperature (*REET*), which is an index of the thermal feeling of a person under the combined influence of temperature, air humidity, wind speed, and solar radiation. The *REET* values are used to describe the climatological properties of the region. On the territory of the RM, on average for 1966-2015, the REET values for the warm period of the year (May-September) varied from 12.1°C to 20.6°C, which describes the weather conditions as "moderately cool" and "cool". In January, the monthly average *REET* values varied from -9.8°C in the North (Briceni) to -8.6°C in the South of the country (Cahul), while in July it was + 17.8°C in the North, up to + 19.9°C in the South (Comrat), with a maximum of + 20.6°C in the east (Dubasari), which describes the weather in the cold season as "very cold" (*REET = -8°C ... -3°C*) and "cold" (*REET = -3°C ... + 2°C*) and in the warm period of the year as "moderately cool" (*REET = + 12°C ... + 17°C*) and "cool" (*REET = + 17°C ... + 21°C*), **Table 5-59.**

Table 5-59: The Radiation-Equivalent Effective Temperature Index, REET, °C (1966-2015)

Stations	Cold period of the year					Warm period of the year				
	I	II	III	XI	XII	V	VI	VII	VIII	IX
Briceni	-9.8	-8.3	-2.8	-1.7	-7.4	12.1	15.6	17.8	17.1	11.7
Soroca	-9.8	-8.5	-2.7	-1.7	-7.4	12.4	15.9	18.2	17.7	12.0
Camenca	-9.3	-7.9	-2.3	-1.2	-6.8	12.9	16.8	19.0	18.3	12.8
Rabnita	-8.5	-7.3	-1.6	-1.5	-6.0	13.2	17.1	19.3	18.6	13.1
Balti	-8.7	-7.2	-1.8	-0.5	-6.2	13.1	16.9	19.1	18.4	12.9
Bravicea	-7.5	-5.9	-0.5	0.7	-4.9	14.0	17.8	19.9	19.1	13.6
Dubasari	-7.7	-6.3	-0.9	0.5	-5.0	14.3	18.3	20.6	19.8	14.3
Baltata	-8.1	-6.7	-1.5	0.0	-5.5	13.0	17.0	19.3	18.7	13.2
Leova	-9.1	-7.3	-1.7	-0.4	-6.6	12.8	16.8	19.1	18.7	13.3
Falesti	-8.4	-6.8	-1.2	-0.2	-6.0	13.5	17.2	19.5	18.9	13.5
Cornesti	-8.8	-7.3	-1.9	-0.7	-6.3	12.8	16.5	18.7	18.1	12.7
Chisinau	-8.0	-6.6	-1.3	0.1	-5.7	13.4	17.3	19.6	19.1	13.6
Comrat	-7.8	-6.2	-1.0	0.6	-5.4	13.4	17.5	19.9	19.4	14.0
Cahul	-8.6	-7.0	-1.7	-0.1	-6.3	12.7	16.8	19.2	18.8	13.5

The *CLTS* values of the *REET* index during the cold period throughout the territory of the RM were statistically significant; had a positive sign and varied from +0.33°C/10 years to 0.67°C/10 years, while R^2 varied from 8% to 28%, which shows an increase in the recreational comfort of the climate in the region. The value of the coefficient of determination, R^2 39-62%, was significantly higher for the warm period of the year with CLTS values from +0.47°C/10 years to +0.73°C/10 years, which shows greater statistical significance of the conclusions on changes towards warming in the recreational and climatic conditions on the territory of the RM, especially during the warm period of the year, **Table 5-60**.

Table 5-60: The REET, °C, Trend Slope (points/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value* for 1966-2015

Stations	Cold period of the year				Warm period of the year			
	REET	*Trend*	R^2	*p-value*	*REET*	*Trend*	R^2	*p-value*
Briceni	-6.0	+0.56	21	**0.0009**	14.9	+0.62	45	**0.0000**
Soroca	-6.0	+0.47	15	**0.0051**	15.2	+0.49	30	**0.0000**
Camenca	-5.5	+0.50	15	**0.0049**	15.9	+0.56	44	**0.0000**
Rabnita	-2.3	+0.58	23	**0.0005**	16.3	+0.66	55	**0.0000**
Balti	-4.9	+0.49	15	**0.0060**	16.0	+0.57	50	**0.0000**
Bravicea	-3.6	+0.50	16	**0.0041**	16.9	+0.64	55	**0.0000**
Dubasari	-3.9	+0.54	21	**0.0010**	17.5	+0.63	55	**0.0000**
Baltata	-4.4	+0.52	19	**0.0015**	16.3	+0.52	46	**0.0000**
Leova	-5.0	+0.67	28	**0.0000**	16.1	+0.73	62	**0.0000**
Falesti	-4.5	+0.54	19	**0.0000**	16.5	+0.65	57	**0.0000**
Cornesti	-2.5	+0.55	20	**0.0011**	15.8	+0.69	56	**0.0000**
Chisinau	-4.3	+0.37	10	**0.0269**	16.6	+0.50	38	**0.0000**
Comrat	-4.0	+0.33	8	**0.0401**	16.8	+0.47	41	**0.0000**
Cahul	-4.7	+0.47	16	**0.0038**	16.2	+0.56	47	**0.0000**

5.4.5.1.6. Observed Trends in Biological Active Temperature (BAT)

The biologically active temperature of the man's environment (*BAT*) allows to determine the combined effect of temperature, air humidity, wind speed, total solar radiation, and long-wave radiation on the underlying surface of man. This bioclimatic indicator was proposed by Andreev, 2005. The comfort zone for this index is between +10°C and +20°C. Within this range, the level of "medium comfort" (from +10°C to +13°C and from +18°C to +20°C) and "high comfort" (from +13°C to +18°C) indices are to be found. Values above +20°C or below 10°C are regarded as "uncomfortable", the range of values from +0°C to +4°C and the values over 26°C are estimated as "uncomfortable"; from +4°C to +7°C and from +23°C to +26° C are "low comfort" indices; values from +7°C to +10°C and from +20°C to +23°C are "moderate comfort" ones.

The cold period of the year, on average for 1966-2015, was described by negative *BAT* values that were in the zone of "hard temperature impact" (*BAT = -5°C ... 0°C*) or "uncomfortable temperature impact" (*BAT = 0°C ... +4°C*). The temperatures varied from -0.3°C (Briceni) to +1.2°C (Comrat) in December, from -2.2°C to -0.7°C in January and from -1.1°C to +0.5°C in February, which negatively affects the health of the people. Out of the entire cold period of the year, only November, on the average for 1966-2015, was described by relatively "warm" with *BAT* index values with low comfort of temperatures (*BAT = 4°C ... 7°C*) over the greater territory of the RM: Camenca, Rabnita, Balti, Bravicea, Dubasari, Baltata, Leova, Falesti, Cornesti, Chisinau, Comrat and Cahul. In May, the BAT values averaged from +14.6°C in the North (Briceni) to +15.7°C in the South (Comrat), on the average for 1966-2015, with a maximum of +16.4°C in Dubasari, which are described as "high comfort" temperatures (*BAT = +13°C ... 18°C*).

During the summer months, on the average for 1966-2015, the observed *BAT* index was from +17.4°C to + 18.9°C in June and from +18.6°C to +20.3°C in August, which describes the bioclimatic conditions on the territory of the RM as, on the whole, "highly comfortable" (*BAT = +13°C … +18°C*) or of "medium comfort" (*BAT = +18°C ... +20°C*). In July, the *BAT* index reached from +19.0°C to +20.3°C, with a maximum of +21.2°C, which described the bioclimatic conditions on the territory of the RM, in general, as being of "medium comfort" and "moderately comfortable" (*BAT = +20°C up to +23°C*).

By the beginning of autumn, the values of the *BAT* index began to decrease; in September *BAT* was from +14.4°C to +16.2°C, which is described as "high comfort" of temperature effects. Thus, it can be argued that the weather conditions during the warm period of the year are, on average, comfortable for a person in the open air, **Table 5-61.**

Table 5-61: The Biologically Active Temperature Index, *BAT*, °C (1966-2015)

Stations	Cold period of the year					Warm period of the year				
	I	II	III	XI	XII	V	VI	VII	VIII	IX
Briceni	-2.2	-1.1	3.2	4.0	-0.3	14.6	17.4	19.0	18.6	14.4
Soroca	-2.2	-1.2	3.3	4.0	-0.3	14.9	17.6	19.4	19.0	14.6
Camenca	-1.9	-0.8	3.6	4.4	0.1	15.3	18.3	20.0	19.4	15.2
Rabnita	-1.2	-0.3	4.1	5.0	0.6	15.6	18.5	20.2	19.7	15.4
Balti	-1.3	-0.2	4.0	4.9	0.6	15.4	18.4	20.1	19.5	15.3
Bravicea	-0.4	0.8	5.0	5.9	1.5	16.2	19.0	20.7	20.1	15.8
Dubasari	-0.6	0.5	4.6	5.7	1.5	16.4	19.5	21.2	20.6	16.4
Baltata	-0.9	0.1	4.2	5.4	1.1	15.4	18.5	20.3	19.8	15.5
Leova	-1.7	-0.3	4.0	5.0	0.3	15.2	18.3	20.0	19.8	15.6
Falesti	-1.2	0.1	4.4	5.2	0.7	15.7	18.6	20.3	19.9	15.8
Cornesti	-1.5	-0.3	3.9	4.8	0.5	15.2	18.1	19.8	19.3	15.2
Chisinau	-0.8	0.3	4.4	5.5	1.0	15.7	18.7	20.5	20.1	15.9
Comrat	-0.7	0.5	4.6	5.8	1.2	15.7	18.9	20.7	20.3	16.2
Cahul	-1.3	0.0	4.1	5.2	0.5	15.1	18.3	20.2	19.8	15.7

The values of the *CLTS* index of *BAT,* on average for 1966-2015, for the cold period throughout the territory of the RM were statistically significant; they had a positive sign and varied from +0.26°C/10 years to +0.52°C/10 years, while R^2 varied from 8% to 28%, showing an increase in the bioclimatic comfort of the climate in the region for the cold season. The value of the determination factor, R^2, of 38-62%, is higher for the warm period of the year with *CLTS* from +0.36°C/10 years to 0.62°C/10 years, which shows a higher statistical significance of the conclusions on changes towards warming in the bioclimatic conditions on the territory of the RM, especially during the warm season, **Table 5-62.**

Table 5-62: The Biologically Active Temperature (*BAT)*, °C, Trend Slope (points/10 years), Coefficient of Determination, R^2 and Statistical Significance of Changes, *p-value* for 1966-2015

Stations	Cold period of the year				Warm period of the year			
	BAT	*Trend*	R^2	*p-value*	*BAT*	*Trend*	R^2	*p-value*
Briceni	0.7	+0.43	21	**0.0009**	16.8	+0.48	45	**0.0000**
Soroca	0.7	+0.36	15	**0.0051**	17.1	+0.38	30	**0.0000**
Camenca	1.1	+0.38	15	**0.0049**	17.6	+0.42	44	**0.0000**
Rabnita	1.6	+0.46	23	**0.0004**	17.9	+0.56	55	**0.0000**
Balti	1.6	+0.38	15	**0.0060**	17.7	+0.44	50	**0.0000**
Bravicea	2.6	+0.38	16	**0.0041**	18.4	+0.49	54	**0.0000**
Dubasari	2.4	+0.42	21	**0.0010**	18.8	+0.48	55	**0.0000**
Baltata	2.0	+0.40	19	**0.0015**	17.9	+0.40	46	**0.0000**
Leova	1.5	+0.52	28	**0.0000**	17.8	+0.56	62	**0.0000**
Falesti	1.9	+0.42	19	**0.0016**	18.1	+0.50	57	**0.0000**
Cornesti	1.5	+0.44	22	**0.0007**	17.5	+0.53	56	**0.0000**
Chisinau	2.1	+0.29	10	**0.0269**	18.2	+0.39	38	**0.0000**
Comrat	2.3	+0.26	8	**0.0401**	18.3	+0.36	41	**0.0000**
Cahul	1.7	+0.36	16	**0.0038**	17.8	+0.43	47	**0.0000**

5.4.5.2. Projections of Future Changes in Bioclimatic Conditions in the RM

5.4.5.2.1. Projections of Future Changes in Bodman Index (BI)

In order to estimate the possible changes in winter bioclimatic conditions, the Bodman severity index projections were modelled for two 30-year periods, 2021-2050, and 2071-2100, according to the ensemble of EURO-CORDEX RCMs for Representative Concentration Pathways RCP8.5 and RCP4.5, relative to reference period, 1971-2000.

Over the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCP8.5 and RCP4.5 scenarios, "moderate-severe" ($2<S<3$) and "mildly severe" ($1<S<2$) winters are expected, **Figure 5-75, Figure 5-76**.

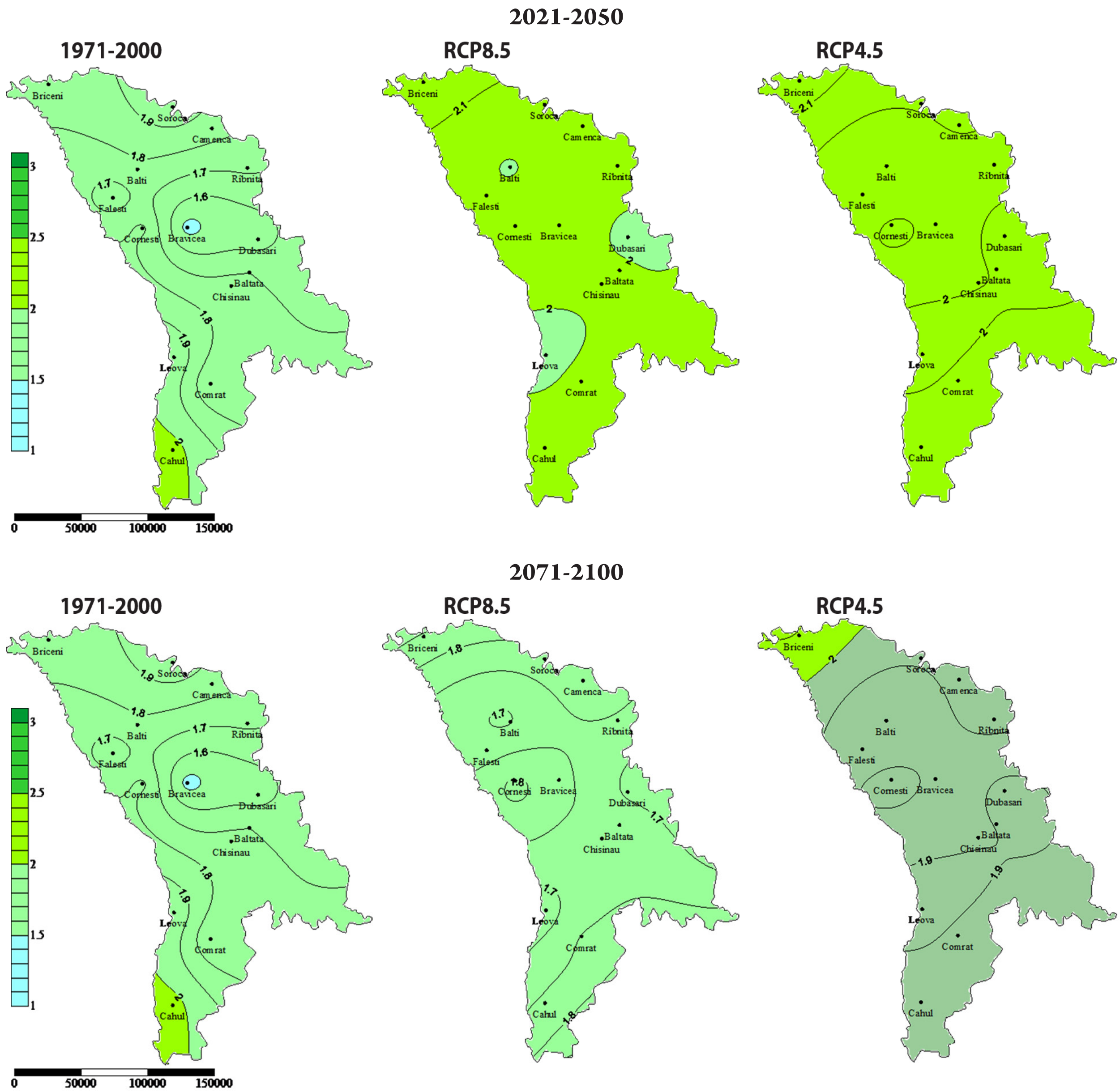


Figure 5-75: Projected Ensemble of EURO-CORDEX RCMs Bodman Winters Severity Index (*S*), Development in Cold Period throughout the RM.

For instance, over the period 2021-2050 the values of the Bodman severity index, S (1), will vary from 1.2 to 1.9 in March and November and from 2.1 to 2.4 in December, January, and February on, virtually, the entire territory of the RM, as compared to the base period, 1971-2000.

A differentiated growth in the Bodman severity index for winter conditions, S (1), is expected, depending on the scenario of greenhouse gas emissions, from 4 to 53% (RCP8.5) and/or from 7 to 48% (RCP4.5) in January and from 1 to 45% in December, according to two scenarios in different regions of the RM. In February, March and November, the maximum increase in Bodman severity index for winter conditions, S (1), will be 34-39%.

Interestingly, in case of the Bodman severity index of winter conditions, S (2), when the daily minimum temperatures were used for modelling, instead of the average daily temperatures, Bodman index projections with a negative sign were obtained. In comparison with the base period, 1971-2000, in 2021-2050 Bodman severity index for winter conditions, S (2), which will be fairly homogeneous throughout the winter period from November to March, is expected to decrease, according to both representative development pathways and it will range from 1% to 26-28% in different regions of the RM.

The greatest warming according to Bodman winter severity index, S (2), due to lower minimum temperatures, is expected on the territories of Soroca, Balti in Northern AEZ, and Leova, Cahul, in Southern AEZ, **Table 5-63.**

Table 5-63: The Possible Projections of the Changes in the Bodman Winter Severity Indices, S (1) and S (2), %, in 2021-2050, According to the Ensemble of EURO-CORDEX RCMs, for Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	January				February				March				November				December			
	RCP 8.5		RCP 4.5		RCP 8.5		RCP 4.5		RCP 8.5		RCP 4.5		RCP 8.5		RCP 4.5		RCP 8.5		RCP 4.5	
	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)
Briceni	26	-5	22	-7	13	-14	11	-15	19	-8	19	-7	16	-9	16	-9	20	-7	19	-8
Soroca	10	-14	7	-16	-1	-21	-2	-22	2	-20	1	-20	4	-19	5	-19	9	-17	8	-18
Camenca	22	-7	19	-10	9	-16	8	-16	7	-17	8	-16	11	-15	12	-15	15	-10	15	-10
Rabnita	26	-2	22	-5	13	-11	12	-11	11	-11	12	-11	15	-9	16	-9	26	-1	26	-1
Balti	23	-11	19	-13	9	-21	8	-22	3	-22	4	-21	6	-17	7	-17	16	-10	15	-10
Bravicea	53	14	48	11	36	3	34	2	37	-2	39	-1	34	2	35	2	45	6	44	6
Dubasari	36	2	31	-1	23	-3	22	-3	26	0	28	1	18	-5	20	-3	28	-1	27	-2
Baltata	32	-5	28	-8	12	-13	12	-13	12	-6	14	-5	12	-21	14	-20	24	-9	24	-9
Leova	0	-24	-3	-26	-6	-28	-6	-28	-4	-27	-3	-26	-5	-26	-3	-25	3	-25	3	-24
Falesti	31	3	26	0	17	-6	15	-7	18	-5	20	-4	23	-2	21	-4	25	2	25	1
Cornesti	22	-4	20	-6	9	-13	10	-13	8	-14	9	-12	11	-8	12	-7	21	-7	23	-6
Chisinau	25	0	20	-4	12	-10	11	-10	11	-10	12	-8	11	-5	12	-4	17	-4	17	-3
Comrat	26	-2	21	-5	14	-10	13	-10	13	-10	15	-9	20	-7	22	-6	25	-5	26	-4
Cahul	4	-17	0	-21	-1	-24	-2	-24	-5	-24	-3	-23	-2	-23	1	-22	1	-22	3	-20

During the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both the RCP8.5 and RCP4.5 scenarios, "moderately severe" ($2<S<3$) and "mildly severe" ($1<S<2$) winters are expected, **Figure 5-75, Figure 5-76**. The values of the Bodman severity index, S (1), for example, will vary from 1.5 to 1.8 points in March and November and from 1.8 to 2.3 in December, January, and February, practically throughout the territory of the RM.

For the Bodman severity index, S (2), calculated using minimal daily temperatures, "moderately severe" ($1<S<2$) and "non severe, mild" ($S<1$) winters are expected, while the values of Bodman severity index, S (2), will vary from 0.8 to 1 point in March and November and from 0.9 to 1.1 points in December, January and February for both representative development pathways RCP8.5 and RCP4.5.

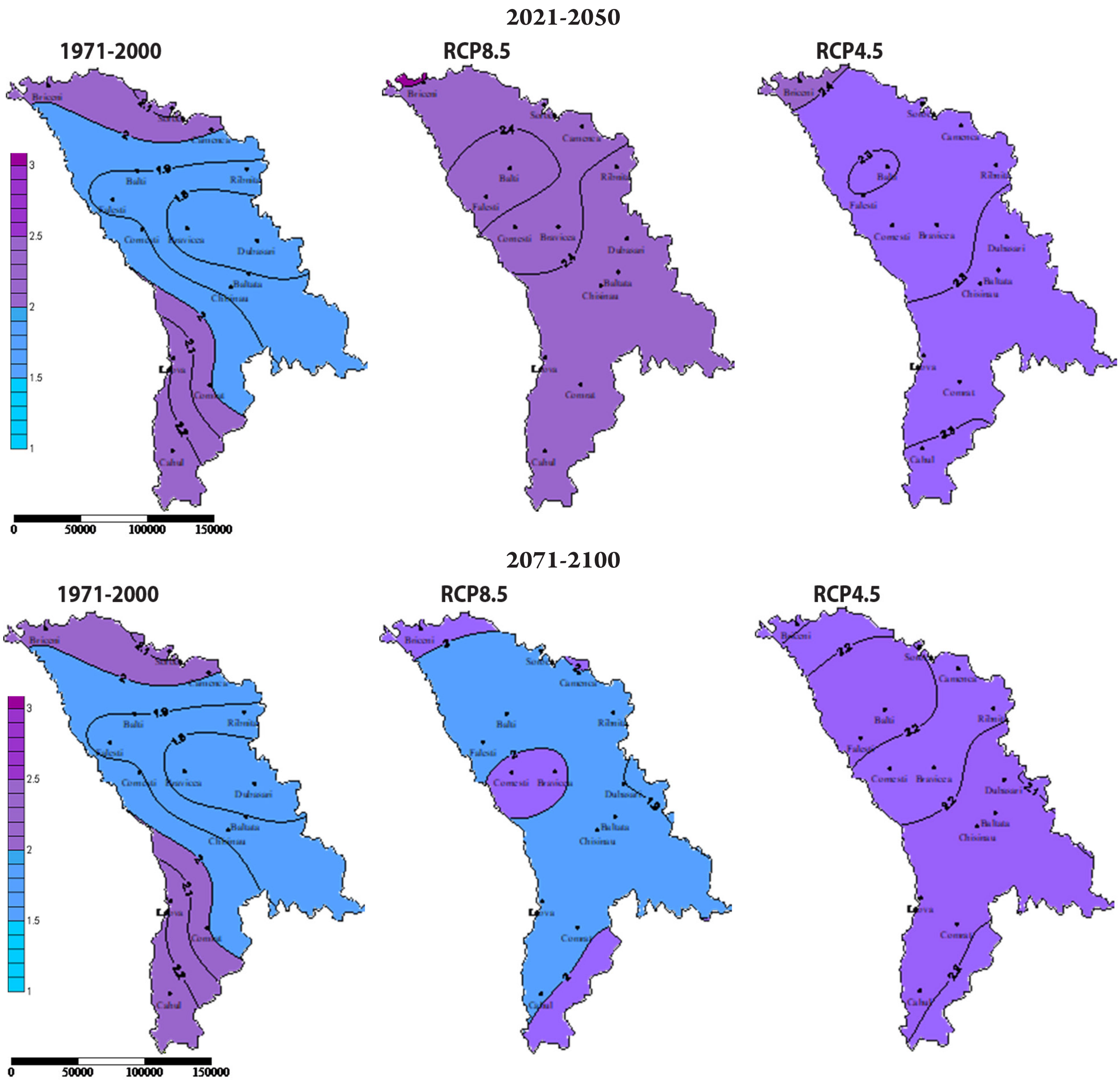


Figure 5-76: Projected Ensemble of EURO-CORDEX RCMs Bodman Winter Severity Index (*S*) Development in Cold Period throughout the RM: January.

Over the period 2071-2100, the trend towards increase in the Bodman severity index for winter conditions, S (1), will continue, which will be higher for the representative development path with average greenhouse gas emissions, from 12 to 40% (RCP4.5) and/or from 2 to 26% (RCP8.5) in January and from 2 to 37% (RCP4.5) and/or from 2 to 25% (RCP8.5) in December, as compared to the base period, 1971-2000. In different regions of the RM, in February, March and November, a maximal growth in Bodman severity index for winter conditions, S (1), from 19% (RCP8.5) to 30% (RCP4.5) is possible, **Figure 5-75, 5-76.**

For the Bodman severity index for winter conditions, S (2), modelled using the minimum daily temperatures, over 2071-2100, a significant decrease in values is expected, which will be quite homogeneous throughout the cold period of the year, from November to March, according to both representative development pathways, and it will be between 54 and 70% in different regions of the RM. The greatest warming in terms of the Bodman severity index for winter conditions, S (2), modelled on the basis of minimum daily temperatures, is expected in the areas of Briceni, Soroca, Balti, Camenca in the Northern AEZ, and Leova, Cahul in the Southern AEZ, **Table 5-64.**

Table 5-64: The Possible Projections of the Changes in the Bodman Winter Severity Indices, S (1) and S (2), %, in 2071-2100, According to the Ensemble of EURO-CORDEX RCMs, for Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	January				February			
	RCP 8.5		RCP 4.5		RCP 8.5		RCP 4.5	
	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)
Briceni	3	-65	16	-61	-4	-67	10	-64
Soroca	-10	-67	0	-64	-15	-69	-6	-66
Camenca	0	-65	12	-62	-7	-67	4	-64
Rabnita	3	-63	17	-59	-3	-65	12	-62
Balti	0	-65	12	-62	-7	-69	5	-66
Bravicea	26	-57	40	-54	16	-60	30	-57
Dubasari	12	-60	24	-57	6	-61	17	-58
Baltata	9	-63	21	-60	-3	-65	8	-63
Leova	-17	-69	-9	-67	-19	-70	-10	-68
Falesti	7	-60	20	-57	0	-63	13	-60
Cornesti	2	-64	13	-61	-6	-66	6	-63
Chisinau	2	-62	14	-59	-4	-64	7	-61
Comrat	4	-63	15	-60	-2	-65	8	-62
Cahul	-14	-68	-6	-66	-15	-70	-6	-68

Station	March				November			
	RCP 8.5		RCP 4.5		RCP 8.5		RCP 4.5	
	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)	S (1)	S (2)
Briceni	1	-64	14	-61	4	-62	14	-59
Soroca	-13	-68	-5	-66	-6	-65	2	-62
Camenca	-9	-67	1	-65	-1	-64	8	-61
Rabnita	-5	-65	9	-62	3	-61	15	-58
Balti	-12	-69	-3	-66	-5	-64	3	-61
Bravicea	17	-62	30	-59	19	-58	30	-54
Dubasari	8	-60	19	-57	6	-59	15	-55
Baltata	-3	-63	7	-60	0	-66	9	-63
Leova	-18	-70	-9	-68	-15	-67	-7	-64
Falesti	1	-62	14	-59	10	-58	19	-55
Cornesti	-7	-66	2	-64	0	-61	8	-59
Chisinau	-4	-64	5	-61	-1	-59	8	-56
Comrat	-3	-65	8	-62	7	-61	17	-58
Cahul	-18	-70	-9	-68	-12	-68	-3	-65

Station	December			
	RCP 8.5		RCP 4.5	
	S (1)	S (2)	S (1)	S (2)
Briceni	4	-63	14	-60
Soroca	-6	-66	2	-64
Camenca	0	-64	8	-61
Rabnita	9	-60	22	-57
Balti	0	-63	9	-60
Bravicea	25	-58	37	-55
Dubasari	10	-61	20	-56
Baltata	8	-63	18	-60
Leova	-10	-68	-2	-66
Falesti	8	-58	19	-55
Cornesti	7	-63	17	-60
Chisinau	2	-61	10	-58
Comrat	9	-62	19	-59
Cahul	-11	-68	-3	-66

Over the years 2021-2050 according to the ensemble of EURO-CORDEX RCMs for both scenarios, over the cold period of the year (November to March), a differential growth in the number of days with severe weather, from 4 to 20 days, is possible with Bodman severity index S (1) (3<*S*<4), as compared to the base period, 1971-2000, in different regions of the RM. The most severe weather conditions are expected in Briceni, Falesti, Cornesti, Bravicea, in the Northern AEZ (17-19 days), Dubasari, Baltata and Chisinau in the Central AEZ (14-16 days) and Comrat in Southern AEZ (13-14 days). The mildest and non severe winter conditions are expected in Leova and Cahul located in the Southern AEZ the increase in the number of days with severe weather being from 0 to 5 days during the cold period, as compared to the base period, 1971-2000.

The trend toward increase in the number of days with severe weather in winter will be maintained over the period 2071-2100 according to the ensemble of EURO-CORDEX RCMs, however, it will be higher in case of the representative development pathway RCP4.5 from 5 to 15 days and/or from 1 to 10 days (RCP8.5), as compared to the base period, 1971-2000, in different regions of Moldova, **Table 5-65.**

5.4.5.2.2. Projections of Future Changes in Effective Temperature (ET)

In the 2021-2050 time period, according to the ensemble of EURO-CORDEX RCMs for both scenarios, over the cold period of the year, a thermal feeling described as "moderate" (*ET = +6°C ... 0°C*) is expected, while *ET* index values will vary from + 1.7°C (Briceni) to + 3.0°C (Comrat), **Figure 5-77; Table 5-66.**

Table 5-65: The Possible Projections of the Change in the Number of Days with Severe Weather During the Cold Period of the Year (November to March), in Bodman Severity Index, S (1) (3<*S*<4), (Days) According to the Ensemble of EURO-CORDEX RCMs for Representative Concentration Pathways RCP8.5 and RCP4.5

Station	1971-2000, Days	2021-2050		2071-2100	
		RCP 8.5	RCP 4.5	RCP 8.5	RCP 4.5
Briceni	9	17	16	5	13
Soroca	11	12	9	0	5
Camenca	7	16	14	5	11
Rabnita	4	16	15	6	14
Balti	8	11	9	1	7
Bravicea	2	20	19	10	15
Dubasari	2	15	14	6	11
Tiraspol	6	11	9	2	7
Baltata	6	14	13	4	10
Leova	16	0	0	-8	-3
Falesti	3	19	15	7	13
Cornesti	6	18	16	6	13
Chisinau	4	16	14	5	11
Comrat	6	14	13	4	10
Cahul	15	5	4	-5	0

Table 5-66: The Projections of the ET Index (°C) for Cold and Warm Periods of the Year According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5

Stations	2021-2050				2071-2100			
	Cold period of the year		Warm period of the year		Cold period of the year		Warm period of the year	
	RCP8.5	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*
Briceni	1.7	1.7	17.0	16.9	4.8	2.5	19.1	17.4
Soroca	2.0	2.0	17.4	17.4	5.0	3.1	19.6	18.1
Camenca	2.2	2.3	17.9	17.7	5.3	3.3	20.0	18.4
Rabnita	2.5	2.6	18.0	17.8	5.5	3.0	20.1	18.3
Balti	2.7	2.7	18.1	17.9	5.6	3.5	20.2	18.7

Stations	2021-2050				2071-2100			
	Cold period of the year		Warm period of the year		Cold period of the year		Warm period of the year	
	RCP8.5	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*
Bravicea	3.0	3.0	18.1	18.1	5.8	3.9	20.3	18.8
Dubasari	3.0	3.0	18.7	18.6	5.8	4.0	20.9	19.3
Baltata	2.9	2.9	18.3	18.2	5.6	3.9	20.5	18.9
Leova	2.8	2.8	18.3	18.1	5.5	3.7	20.5	18.9
Falesti	2.5	2.6	18.0	18.1	5.5	3.4	20.1	18.6
Cornesti	2.4	2.6	17.7	17.7	5.3	3.5	19.9	18.4
Chisinau	3.0	3.0	18.5	18.4	5.8	4.0	20.6	19.1
Comrat	3.0	3.1	18.8	18.5	5.8	4.0	20.9	19.2
Cahul	2.9	3.0	18.6	18.4	5.6	3.9	20.8	19.1

As compared with the base period, 1971-2000, in 2021-2050, over the cold season, a differentiated growth in the *ET* index is expected from +0.9°C to +1.3°C (RCP8.5) and/or from +1.5°C to +1.8°C (RCP4.5) in January and from +1.1°C to +1.5°C in December, respectively in different regions of the RM. In February, maximum increase in the *ET* index from +2.2°C to +2.8°C as compared to the base period, 1971-2000, is possible.

The greatest increase in the bioclimatic comfort over the cold season, according to the *ET* index, is expected in Briceni, Soroca, Balti, Rabnita and Camenca (in Northern AEZ), while the lowest is expected in Comrat and Cahul (Southern AEZ), **Table 5-67**.

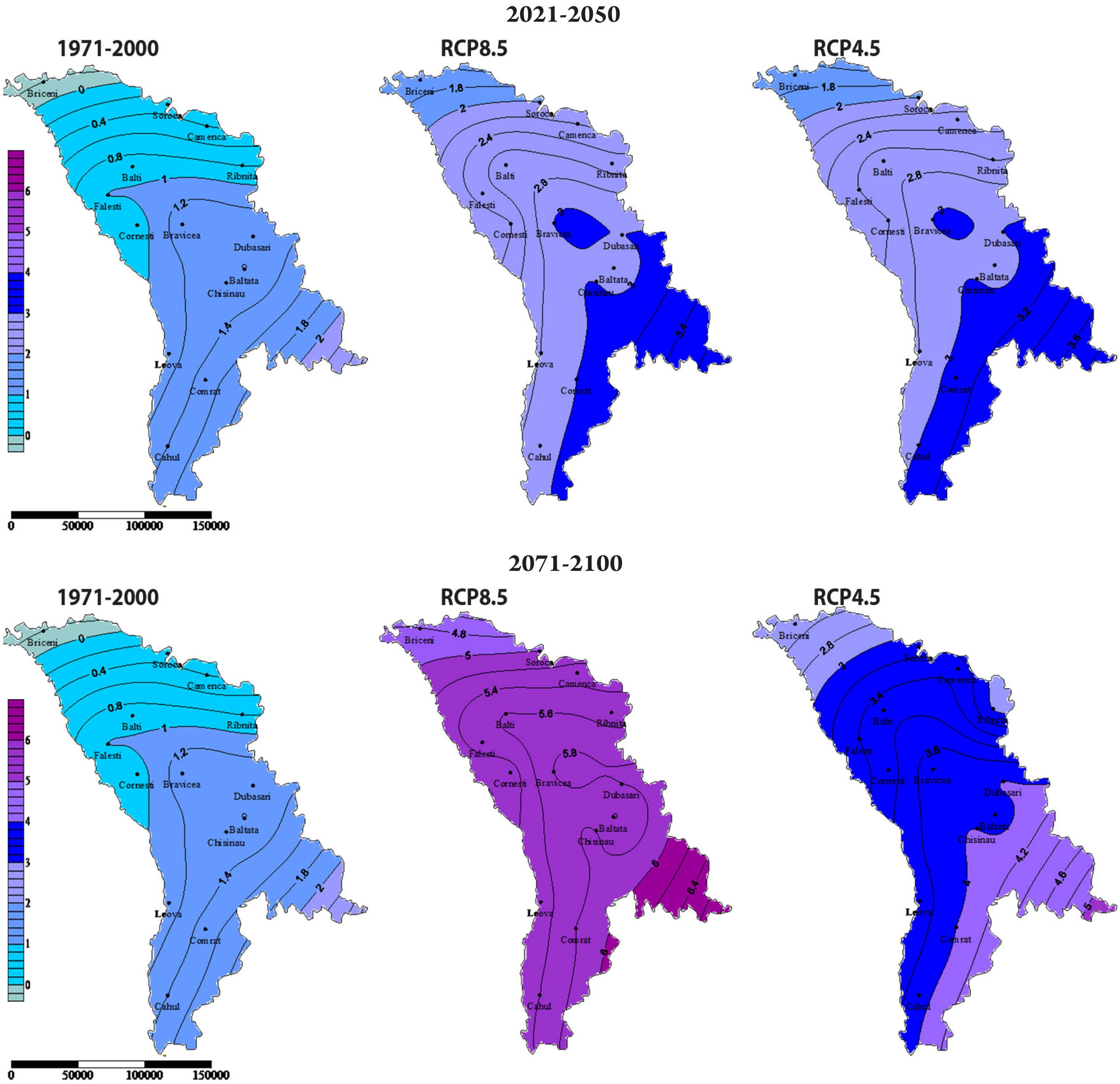


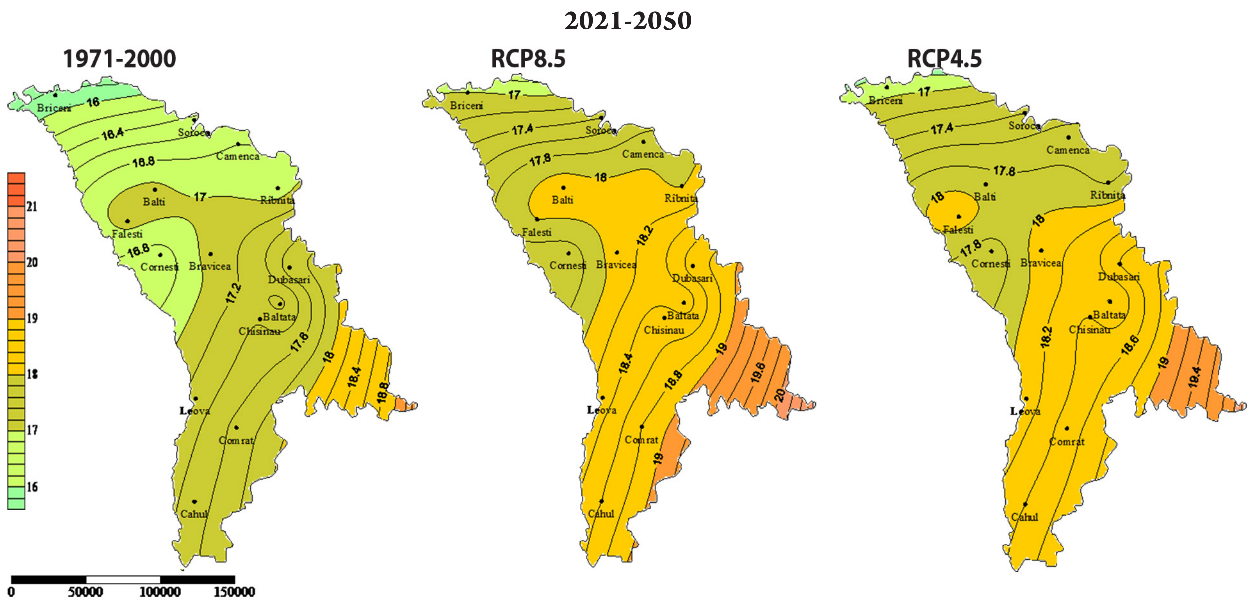
Figure 5-77: Projected Ensemble of EURO-CORDEX RCMs Effective Temperature (*ET*) Index Development in Cold Period throughout the RM.

Table 5-67: The Possible Projections of Changes in the ET Index, °C, for Cold Period of Year, According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Cold period of the year									
	January		February		March		November		December	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	1.3	1.7	2.5	2.6	2.3	2.2	1.5	1.3	1.5	1.4
Soroca	1.0	1.5	2.5	2.7	2.1	2.1	1.5	1.2	1.5	1.4
Camenca	1.3	1.8	2.6	2.8	2.2	2.2	1.5	1.2	1.5	1.3
Rabnita	1.2	1.7	2.5	2.7	2.2	2.1	1.5	1.1	1.5	1.3
Balti	1.3	1.7	2.6	2.7	2.2	2.1	1.5	1.2	1.5	1.3
Bravicea	1.1	1.6	2.4	2.5	2.0	1.9	1.5	1.2	1.3	1.3
Dubasari	1.1	1.7	2.4	2.6	2.0	1.9	1.5	1.1	1.3	1.2
Baltata	1.0	1.6	2.4	2.5	2.1	1.9	1.5	1.2	1.4	1.2
Leova	1.1	1.6	2.3	2.6	1.9	1.8	1.5	1.2	1.4	1.2
Falesti	1.0	1.5	2.2	2.6	1.9	1.7	1.2	1.3	1.2	1.1
Cornesti	0.9	1.6	2.2	2.4	1.9	1.9	1.3	1.2	1.1	1.2
Chisinau	1.0	1.6	2.3	2.5	2.0	1.9	1.5	1.2	1.3	1.2
Comrat	1.0	1.6	2.2	2.4	1.8	1.7	1.4	1.1	1.3	1.2
Cahul	0.9	1.6	2.2	2.4	1.8	1.7	1.4	1.1	1.3	1.1
2071-2100										
Briceni	5.4	2.9	6.1	3.3	5.1	3.2	3.6	1.7	4.5	2.3
Soroca	5.1	3.0	5.8	3.7	4.8	3.2	3.5	1.9	4.4	2.5
Camenca	5.4	3.0	6.0	3.7	5.0	3.3	3.5	1.9	4.4	2.5
Rabnita	5.2	2.5	5.7	2.9	4.8	2.6	3.5	1.3	4.3	1.8
Balti	5.2	3.0	5.9	3.7	4.9	3.1	3.6	1.9	4.3	2.4
Bravicea	4.9	2.8	5.4	3.3	4.6	2.9	3.5	1.9	4.1	2.3
Dubasari	4.9	2.8	5.4	3.4	4.5	2.9	3.5	1.9	4.2	2.4
Baltata	4.7	2.6	5.3	3.3	4.5	2.9	3.5	2.0	4.1	2.3
Leova	4.8	2.7	5.3	3.3	4.4	2.8	3.6	1.9	4.2	2.3
Falesti	5.0	2.6	5.6	3.1	4.6	2.5	3.3	1.6	4.1	2.0
Cornesti	4.8	2.8	5.4	3.3	4.6	2.9	3.3	1.9	4.0	2.3
Chisinau	4.7	2.7	5.2	3.3	4.5	2.9	3.5	1.9	4.1	2.3
Comrat	4.6	2.6	5.1	3.2	4.3	2.7	3.5	1.9	4.0	2.3
Cahul	4.4	2.6	4.9	3.2	4.2	2.7	3.5	1.9	3.9	2.2

Over the warm season of the period 2021-2050, according to the ensemble of regional EURO-CORDEX models for both RCPs scenarios, thermal feelings described as "moderately warm" (*ET = +12°C ... +18°C*) and "warm" (*ET = +18°C ... +24°C*), with comfortable load are expected. The values of the *ET* index will vary from +17.0°C in Briceni to +18.8°C in Comrat, respectively, **Figure 5-78; Table 5-66.**

In comparison with the base period, 1971-2000, over the period 2021-2050, according to both RCPs, over the warm period of the year (May to September), the *ET* index is expected to increase from +0.7°C to +1.1°C in July and September in different regions of the RM. In May and June, the maximum growth of the *ET* index is possible, from +1.1°C to +1.5°C as compared to the base period, 1971-2000, **Table 5-68.**



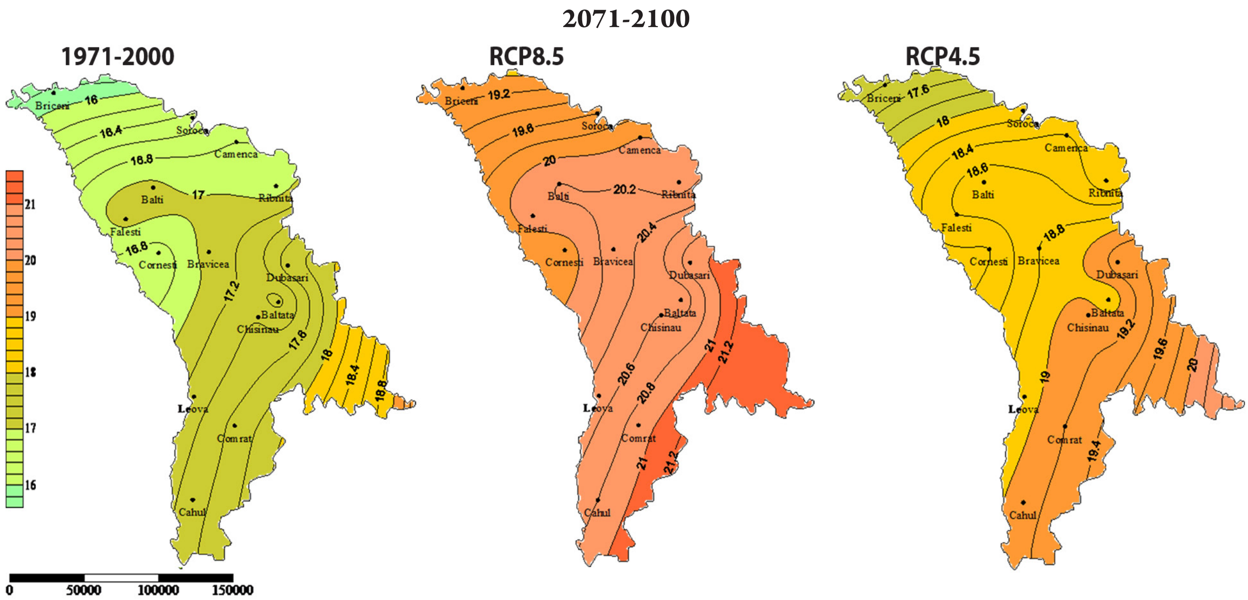


Figure 5-78: Projected Ensemble of EURO-CORDEX RCMs Effective Temperature (*ET*) Index Development in Warm Period throughout the RM in 2021-2050.

By the end of the century, on the territory of the RM, according to the ensemble of EURO-CORDEX RCMs for both RCPs, bioclimatic conditions described as "moderate" (*ET = +6°C ... +0°C*) are expected during the cold period. The values of the *ET* index will vary according to the RCP4.5 scenario from +2.5°C (Briceni) to +4.0°C (Comrat) and/or from +4.8°C (Briceni) to +5.8°C (Comrat) according to scenario RCP8.5, **Figure 5-77; Table 5-66.**

Over the period 2071-2100, the trend towards increase in the comfort of thermal feeling during the cold period of the year will be maintained, which will be significantly higher for RCP with high warming, from +2.6°C to +3.0°C (RCP4.5) and/or from +4.4°C to +5.4 (RCP8.5) in January and from +1.8°C to +2.5°C (RCP4.5) and/or from +3.9°C to +4.5°C (RCP8.5) in December, as compared to the base period, 1971- 2000, in different regions of the RM. In February, the *ET* index is expected to grow from +2.9°C to +3.7°C (RCP4.5) and/or from +4.9°C to +6.1°C (RCP8.5), **Table 5-67.**

During the warm season of the year, over the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, bioclimatic conditions described as "warm" with comfortable load are expected on most of the territory of the RM (*ET = +18°C ... +24°C*). The *ET* values will vary from +17.4°C (RCP4.5) and/or +19.1°C (RCP8.5) in Briceni to +19.2°C (RCP4.5) and/or +20.9°C (RCP8.5) in Comrat, **Figure 5-78; Table 5-66.**

Over the period 2071-2100, the trend towards an increase in the *ET* index during the warm period of the year will be maintained; it will be significantly higher for a RCP with high warming, from +1.3°C to +1.6°C (RCP4.5) and/or from +3.0°C to +3.3°C (RCP8.5) in July and from +1.2°C to +1.6°C (RCP4.5) and/or from +3.0°C to +3.4°C (RCP8.5) in September, as compared to the base period, 1971-2000, in different regions of the RM. In June, the maximum growth of the *ET* index is expected, from +1.7°C to +2.1°C (RCP4.5) and/or from +3.2°C to +3.6°C (RCP8.5), **Table 5-68.**

Table 5-68: The Possible Projections of Changes in the ET Index, ºC, for Warm Period of Year According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Warm period of the year									
	May		June		July		August		September	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	1.5	1.2	1.3	1.3	1.1	1.1	0.7	0.7	1.0	0.8
Soroca	1.4	1.2	1.2	1.2	0.8	1.0	0.6	0.7	0.9	0.8
Camenca	1.6	1.3	1.3	1.2	0.9	0.8	0.7	0.6	1.0	0.8
Rabnita	1.5	1.2	1.3	1.2	0.9	0.8	0.7	0.6	1.0	0.8
Balti	1.5	1.2	1.3	1.2	0.8	0.8	0.6	0.4	1.0	0.8
Bravicea	1.5	1.2	1.3	1.3	0.8	0.9	0.6	0.6	1.0	1.0
Dubasari	1.4	1.2	1.3	1.2	0.8	0.8	0.6	0.4	1.0	0.8
Baltata	1.5	1.2	1.4	1.3	0.9	0.9	0.8	0.7	1.1	1.0
Leova	1.5	1.1	1.2	1.1	0.8	0.7	0.7	0.6	1.1	0.8
Falesti	1.3	1.2	1.2	1.3	0.7	0.9	0.5	0.7	0.7	0.9
Cornesti	1.4	1.2	1.2	1.3	0.8	0.9	0.6	0.6	0.8	0.9
Chisinau	1.5	1.2	1.4	1.3	0.9	0.9	0.7	0.7	1.0	0.9
Comrat	1.5	1.1	1.3	1.2	0.9	0.7	0.8	0.5	1.1	0.8
Cahul	1.5	1.1	1.4	1.3	1.0	0.8	0.8	0.5	1.1	0.8

Station	Warm period of the year									
	May		June		July		August		September	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2071-2100										
Briceni	3.2	1.9	3.4	1.8	3.3	1.6	3.1	1.2	3.4	1.4
Soroca	3.0	2.0	3.2	2.0	3.1	1.5	3.1	1.4	3.3	1.6
Camenca	3.2	2.1	3.4	2.0	3.2	1.4	3.0	1.3	3.3	1.5
Rabnita	3.2	1.6	3.5	1.7	3.1	1.3	3.0	1.1	3.3	1.2
Balti	3.2	2.0	3.4	1.9	3.1	1.3	2.9	1.2	3.4	1.5
Bravicea	3.2	2.1	3.4	2.0	3.1	1.5	2.9	1.3	3.3	1.6
Dubasari	3.2	2.1	3.5	2.0	3.2	1.4	2.9	1.1	3.2	1.4
Baltata	3.2	2.1	3.6	2.0	3.2	1.6	3.1	1.4	3.5	1.6
Leova	3.2	1.9	3.4	1.9	3.0	1.3	3.0	1.2	3.4	1.5
Falesti	3.1	1.9	3.3	1.9	3.0	1.3	2.9	1.3	3.0	1.4
Cornesti	3.1	2.1	3.4	2.1	3.2	1.5	3.0	1.4	3.1	1.6
Chisinau	3.2	2.1	3.6	2.1	3.2	1.5	3.0	1.3	3.3	1.5
Comrat	3.2	1.9	3.4	1.9	3.1	1.4	2.9	1.2	3.3	1.5
Cahul	3.3	1.9	3.6	2.0	3.2	1.5	3.0	1.3	3.3	1.5

5.4.5.2.3. Projections of Future Changes in Equivalent-Effective Temperature of Miserand (EET)

Over the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, thermal feelings described as "very cold" (*EET = -18°C ... -24°C*) are expected during the cold season of the year, while the values of the *EET* index will vary from -20.8°C (Briceni) to -18.8°C (Comrat), **Figure 5-79; Table 5-69.**

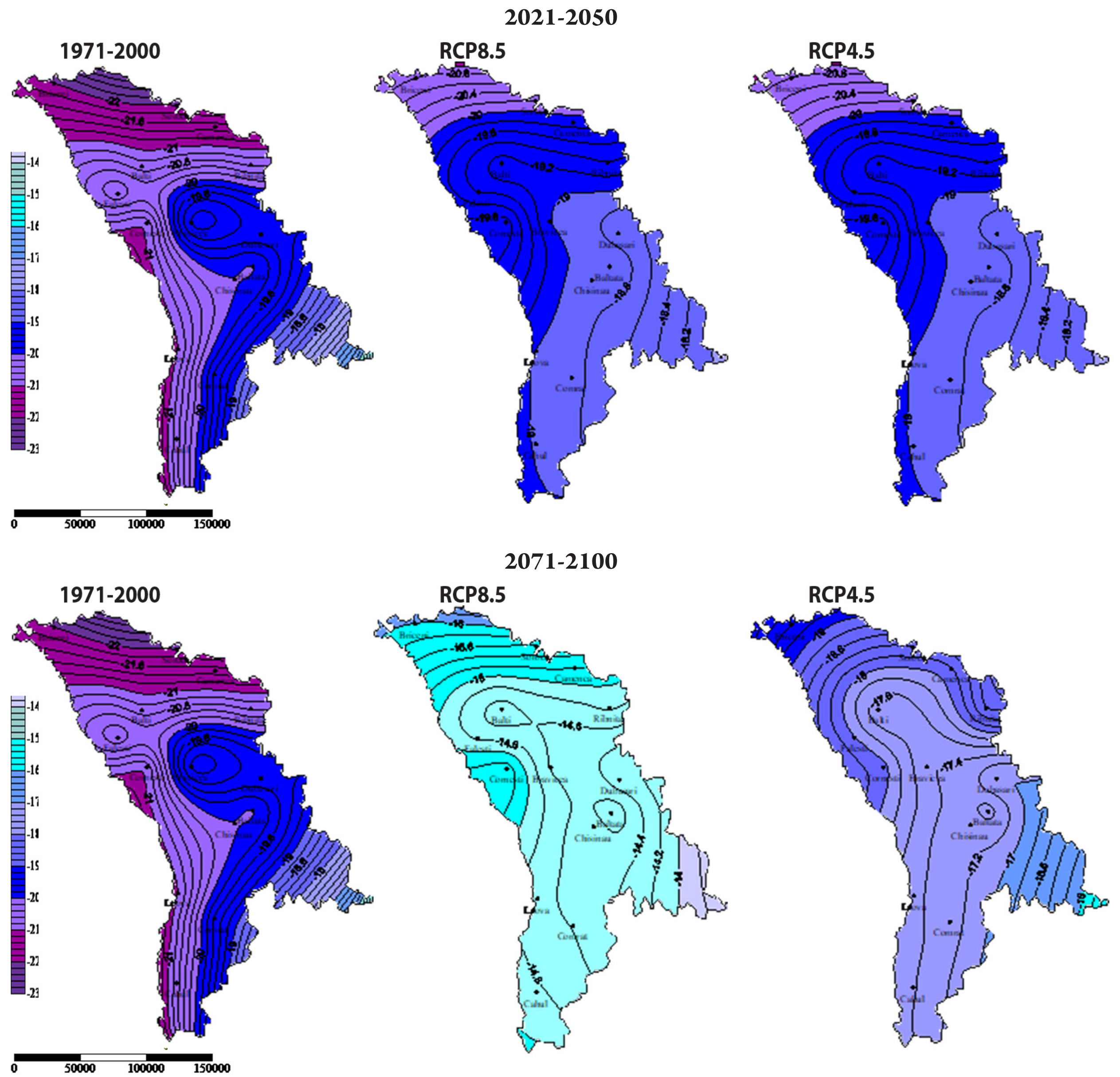


Figure 5-79: Projected Ensemble of EURO-CORDEX RCMs (*EET)* Index Development in Cold Period throughout the RM.

Table 5-69: The Projections of the *EET* Index, by Missenard for Cold and Warm Periods of the Year, According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5

Stations	1971-2000		2021-2050				2071-2100			
	Cold period of the year	Warm period of the year	Cold period of the year		Warm period of the year		Cold period of the year		Warm period of the year	
			RCP8.5	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*
Briceni	-22.0	2.7	-20.8	-20.7	3.3	3.1	-16.0	-19.4	6.7	4.1
Soroca	-22.0	3.3	-20.2	-20.1	4.2	4.1	-15.6	-18.4	7.6	5.3
Camenca	-21.5	4.1	-19.9	-19.8	4.8	4.5	-15.2	-18.2	8.3	5.7
Rabnita	-20.6	4.5	-19.4	-19.3	5.1	4.8	-14.8	-18.6	8.5	5.5
Balti	-20.7	4.3	-19.1	-19.1	5.2	4.9	-14.5	-17.5	8.6	6.1
Bravicea	-19.2	5.3	-19.0	-19.0	5.1	5.1	-14.6	-17.5	8.6	6.2
Dubasari	-19.5	6.0	-18.7	-18.6	6.1	5.9	-14.3	-17.0	9.7	7.1
Baltata	-20.0	4.6	-19.0	-19.0	5.5	5.2	-14.7	-17.5	9.0	6.4
Leova	-21.0	4.3	-19.0	-19.0	5.6	5.3	-14.7	-17.5	9.2	6.5
Falesti	-20.1	4.9	-19.4	-19.3	4.9	5.1	-14.8	-18.0	8.4	6.0
Cornesti	-20.9	3.8	-19.9	-19.6	4.5	4.5	-15.3	-18.1	8.0	5.6
Chisinau	-20.0	5.0	-18.9	-18.8	5.7	5.5	-14.5	-17.3	9.3	6.7
Comrat	-19.6	5.3	-18.9	-18.8	6.0	5.6	-14.6	-17.3	9.5	6.8
Cahul	-20.7	4.4	-19.0	-18.9	5.8	5.4	-14.8	-17.4	9.4	6.7

In comparison with the base period, 1971-2000, over the period 2021-2050, a differentiated growth of the *EET* index is expected during the cold season, depending on the Representative Concentration Pathways, from +0.1°C to +1.1°C (RCP8.5) and/or from +0.7°C to +1.9°C (RCP4.5) In January and from +0.1°C to +1.5°C in December, according to two scenarios, in different regions of the RM. In February and March, maximum increase in the *EET* index is possible, from +0.5°C to +3.4°C as compared to the base period, 1971-2000, **Table 5-70**.

Table 5-70: The Possible Projections of the Change in the EET Index, by Missenard for Cold Period of Year, According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Cold period of the year									
	January		February		March		November		December	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	0.4	1.2	2.6	2.7	1.8	1.7	0.9	0.5	0.6	0.5
Soroca	0.7	1.6	3.2	3.4	2.3	2.3	1.6	1.1	1.4	1.3
Camenca	0.7	1.5	3.0	3.1	2.4	2.2	1.3	0.8	0.9	0.8
Rabnita	0.1	1.0	2.5	2.7	1.9	1.7	0.9	0.4	0.5	0.4
Balti	0.5	1.4	3.0	3.1	2.3	2.1	1.3	0.8	0.8	0.7
Bravicea	-1.0	0.0	1.3	1.4	0.8	0.5	0.0	-0.4	-0.5	-0.6
Dubasari	-0.2	0.9	1.9	2.2	1.2	1.0	0.6	0.0	0.3	0.2
Baltata	-0.2	0.8	2.2	2.3	1.7	1.5	0.9	0.4	0.3	0.1
Leova	1.1	1.9	3.1	3.3	2.4	2.2	1.9	1.4	1.5	1.2
Falesti	-0.2	0.7	2.0	2.4	1.4	0.9	0.4	0.5	0.2	-0.1
Cornesti	0.0	1.1	2.2	2.4	1.8	1.7	0.8	0.7	0.3	0.5
Chisinau	0.1	1.1	2.3	2.5	1.8	1.6	1.0	0.6	0.7	0.5
Comrat	-0.3	0.8	1.8	2.1	1.2	1.0	0.7	0.2	0.3	0.0
Cahul	0.7	1.8	2.7	2.9	2.2	2.0	1.8	1.2	1.4	1.1
2071-2100										
Briceni	6.9	3.0	7.9	3.8	6.2	3.2	4.1	1.2	5.3	2.0
Soroca	7.1	3.8	8.2	5.0	6.5	4.1	4.7	2.3	5.9	3.1
Camenca	7.0	3.4	8.1	4.7	6.7	4.0	4.4	1.9	5.4	2.6
Rabnita	6.4	2.3	7.4	3.2	6.0	2.6	4.0	0.8	5.0	1.3
Balti	6.8	3.3	7.9	4.6	6.4	3.8	4.5	1.9	5.3	2.4
Bravicea	5.0	1.8	5.9	2.7	4.8	2.2	3.1	0.7	3.9	1.1
Dubasari	5.8	2.6	6.5	3.5	5.1	2.7	3.7	1.3	4.7	2.1
Baltata	5.7	2.4	6.6	3.6	5.5	3.1	4.0	1.6	4.5	1.8
Leova	6.9	3.7	7.6	4.6	6.3	3.8	5.0	2.5	5.7	2.9
Falesti	6.1	2.4	7.0	3.3	5.5	2.4	3.6	1.1	4.7	1.4
Cornesti	6.2	3.0	7.1	3.9	5.9	3.4	4.0	1.8	4.8	2.1
Chisinau	6.1	2.9	6.8	3.8	5.7	3.2	4.2	1.7	5.0	2.3
Comrat	5.5	2.4	6.2	3.4	5.1	2.7	3.8	1.4	4.5	1.8
Cahul	6.2	3.4	6.9	4.3	6.0	3.7	4.9	2.5	5.4	2.8

Over the warm season of the year, during period 2021-2050, according to the ensemble of regional EURO-CORDEX models for both RCPs scenarios, bioclimatic conditions descried as "moderately cool" (*EET = 0°C ... +6°C*) are expected. The values of the *EET* index will vary, on the average for the warm period, from +3.1°C in Briceni to +6.0°C in Comrat, **Figure 5-80; Table 5-69.**

In comparison with the base period, 1971-2000, over the period 2021-2050, a differentiated growth of the *EET* index for the warm season of the year (from May to September) is expected, according to both RCPs, from +0.1°C to +1.3°C in July and September in different regions of the RM. In May and June, the maximum increase in the *EET* index is possible, from +0.3°C to +2.0°C, as compared to the base period, 1971-2000, **Table 5-71.**

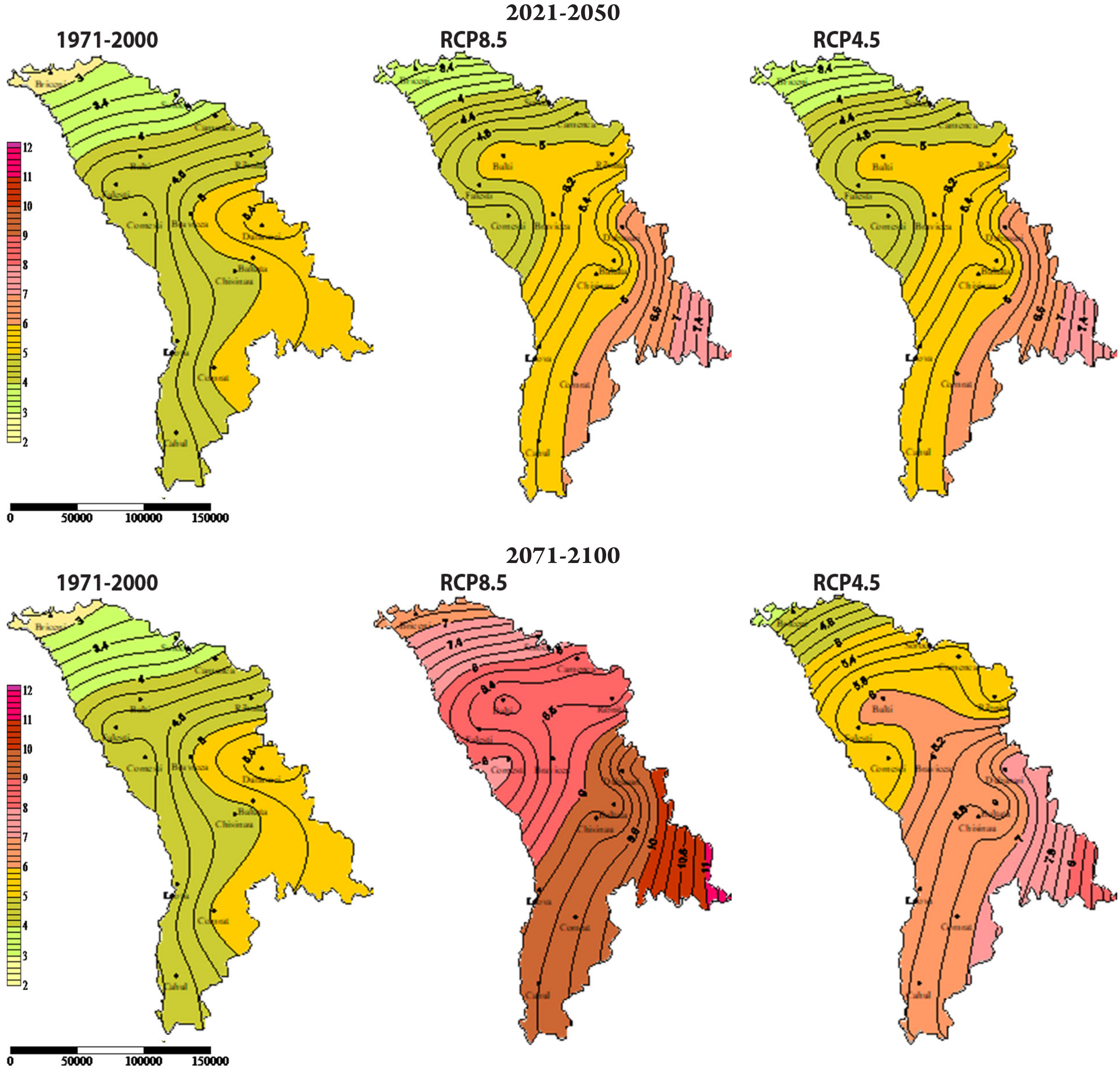


Figure 5-80: Projected Ensemble of EURO-CORDEX RCMs *EET* Index Development in Warm Period throughout the RM.

During the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs, bioclimatic conditions described as "cold" (*EET = -12°C ... -18°C*) are expected during the cold season, while in some regions, for the scenario RCP4.5, close to "very cold" (*EET = -18°C ... -24°C*) conditions are expected. The values of the *EET* index will vary during the cold period from -19.4°C (Briceni) to -17.3°C (Comrat) according to the RCP4.5 and/or from -16.0°C (Briceni) to -14.6°C (Comrat) under RCP8.5 scenarios, **Figure 5-79; Table 5-69**.

The trend towards an increase in the *EET* index for the cold period of the year will be maintained; the index will be significantly higher for a RCP with high warming, from +1.8°C to +3.8°C (RCP4.5) and/or from +5.0°C to +7.1°C (RCP8.5) in January and from +1.1°C to +3.1°C (RCP4.5) and/or from +3.9°C to +5.9°C (RCP8.5) in December, as compared to the base period, 1971-2000, in different regions of Moldova. In February, the maximum increase in the *EET* index, from +2.7°C to +5.0°C (RCP4.5) and/or from +5.9°C to +8.2°C (RCP8.5) is expected, **Table 5-70**.

During the warm season of the year, for the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, bioclimatic conditions described as "cool" (*EET = +6°C ... +12°C*) are expected. The values of the *EET* index will vary from +4.1°C (RCP4.5) and/or +6.7°C (RCP8.5) in Briceni to +6.8°C (RCP4.5) and/or +9.5°C (RCP8.5) in Comrat, **Figure 5-80; Table 5-69**.

Over the period 2071-2100 the trend towards an increase in the *EET* index for the warm period of the year will be maintained; it will be significantly higher for RCP with high warming, from +0.8°C to +2.2°C (RCP4.5) and/or from +3.5°C to +5.1°C (RCP8.5) in July and from +0.3°C to +1.9°C (RCP4.5) and/or from +3.2°C to +5.0°C (RCP8.5) in September, as compared to the base period, 1971- 2000, in different regions of the RM. In June, the maximum *EET* index is expected to grow from +1.6°C to +2.8°C (RCP4.5) and/or from +3.8°C to +5.4°C (RCP8.5), **Table 5-71.**

Table 5-71: The Possible Projections of Change in the EET Index, by Missenard, °C, According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Warm period of the year									
	May		June		July		August		September	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	1.1	0.7	1.0	0.9	0.8	0.8	-0.1	-0.2	0.3	-0.1
Soroca	1.6	1.1	1.2	1.2	0.7	0.9	0.2	0.3	0.6	0.3
Camenca	1.5	1.0	1.0	0.9	0.4	0.4	0.1	-0.2	0.4	0.0
Rabnita	1.3	0.7	0.9	0.8	0.4	0.3	-0.1	-0.3	0.3	0.0
Balti	1.7	1.2	1.3	1.2	0.7	0.7	0.1	-0.1	0.5	0.1
Bravicea	0.5	0.1	0.3	0.4	-0.3	-0.2	-0.8	-0.8	-0.4	-0.5
Dubasari	0.6	0.2	0.6	0.4	0.1	0.0	-0.5	-0.8	-0.1	-0.4
Baltata	1.5	1.0	1.3	1.2	0.7	0.6	0.2	-0.1	0.5	0.2
Leova	2.0	1.4	1.6	1.5	1.0	0.8	0.7	0.4	1.3	0.8
Falesti	0.8	0.5	0.4	0.7	-0.1	0.1	-0.5	-0.2	-0.2	0.0
Cornesti	1.3	1.1	1.0	1.1	0.5	0.6	0.0	0.1	0.4	0.4
Chisinau	1.4	0.9	1.2	1.1	0.6	0.6	0.3	0.1	0.5	0.2
Comrat	1.2	0.7	1.1	0.9	0.6	0.3	0.2	-0.2	0.6	0.1
Cahul	1.9	1.4	1.8	1.6	1.2	1.0	0.9	0.5	1.3	0.8
2071-2100										
Briceni	3.7	1.8	4.2	1.8	4.4	1.5	3.9	0.7	4.0	0.5
Soroca	4.0	2.5	4.4	2.5	4.4	1.8	4.2	1.5	4.3	1.5
Camenca	4.1	2.4	4.4	2.1	4.2	1.3	4.0	1.0	4.1	1.0
Rabnita	3.8	1.5	4.3	1.6	4.1	1.0	3.9	0.6	4.0	0.3
Balti	4.3	2.6	4.7	2.4	4.5	1.5	4.1	1.1	4.2	1.1
Bravicea	3.1	1.4	3.8	1.6	3.5	0.8	3.2	0.4	3.2	0.1
Dubasari	3.4	1.6	4.1	1.7	4.0	1.0	3.4	0.4	3.5	0.4
Baltata	4.1	2.3	4.8	2.3	4.5	1.6	4.2	1.1	4.4	1.1
Leova	4.8	2.8	5.2	2.7	4.8	1.9	4.7	1.6	5.0	1.8
Falesti	3.4	1.7	3.8	1.7	3.6	0.8	3.4	0.7	3.5	0.6
Cornesti	3.9	2.4	4.4	2.3	4.3	1.5	4.0	1.4	4.1	1.2
Chisinau	4.1	2.3	4.7	2.3	4.5	1.6	4.2	1.3	4.2	1.1
Comrat	4.0	2.0	4.6	2.1	4.4	1.5	4.1	1.1	4.2	0.9
Cahul	4.8	2.7	5.4	2.8	5.1	2.2	4.8	1.8	5.0	1.9

5.4.5.2.4. Projections of Future Changes in Normally Equivalent Effective Temperature (NEET)

Over the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, thermal feelings described as "cold discomfort" (*NEET = -18°C ... 0°C*) are expected during the cold period of the year, while the values of the *NEET* index will vary from -9.6°C (Briceni) to -8.0°C (Comrat), **Figure 5-81; Table 5-72.**

Table 5-72: The Projections of the NEET, °C, for the Cold and Warm Periods of the Year, According to the Ensemble of EURO-CORDEX RCMs, under RCP8.5 and RCP4.5

Stations	1971-2000		2021-2050				2071-2100			
	Cold period of the year	Warm period of the year	Cold period of the year		Warm period of the year		Cold period of the year		Warm period of the year	
			RCP8.5	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*
Briceni	-10.6	9.2	-9.6	-9.6	9.7	9.5	-5.8	-8.5	12.4	10.3
Soroca	-10.6	9.6	-9.2	-9.1	10.3	10.3	-5.5	-7.7	13.1	11.2
Camenca	-10.2	10.3	-8.9	-8.9	10.8	10.6	-5.2	-7.6	13.6	11.6
Rabnita	-9.5	10.6	-8.5	-8.5	11.0	10.8	-4.9	-7.9	13.8	11.4
Balti	-9.6	10.4	-8.3	-8.3	11.1	10.9	-4.6	-7.0	13.9	11.9
Bravicea	-8.3	11.2	-8.2	-8.2	11.1	11.0	-4.7	-7.0	13.9	12.0
Dubasari	-8.6	11.8	-8.0	-7.9	11.9	11.7	-4.4	-6.6	14.8	12.7
Baltata	-9.0	10.7	-8.2	-8.2	11.4	11.2	-4.8	-7.0	14.2	12.1
Leova	-9.8	10.4	-8.2	-8.2	11.5	11.2	-4.7	-7.0	14.3	12.2
Falesti	-9.1	10.9	-8.5	-8.4	10.9	11.1	-4.8	-7.4	13.7	11.8
Cornesti	-9.7	10.1	-8.9	-8.7	10.6	10.6	-5.2	-7.5	13.4	11.5
Chisinau	-9.0	11.0	-8.1	-8.0	11.6	11.4	-4.6	-6.8	14.4	12.4
Comrat	-8.7	11.2	-8.1	-8.0	11.8	11.5	-4.7	-6.8	14.6	12.5
Cahul	-9.6	10.5	-8.2	-8.2	11.6	11.3	-4.9	-6.9	14.5	12.3

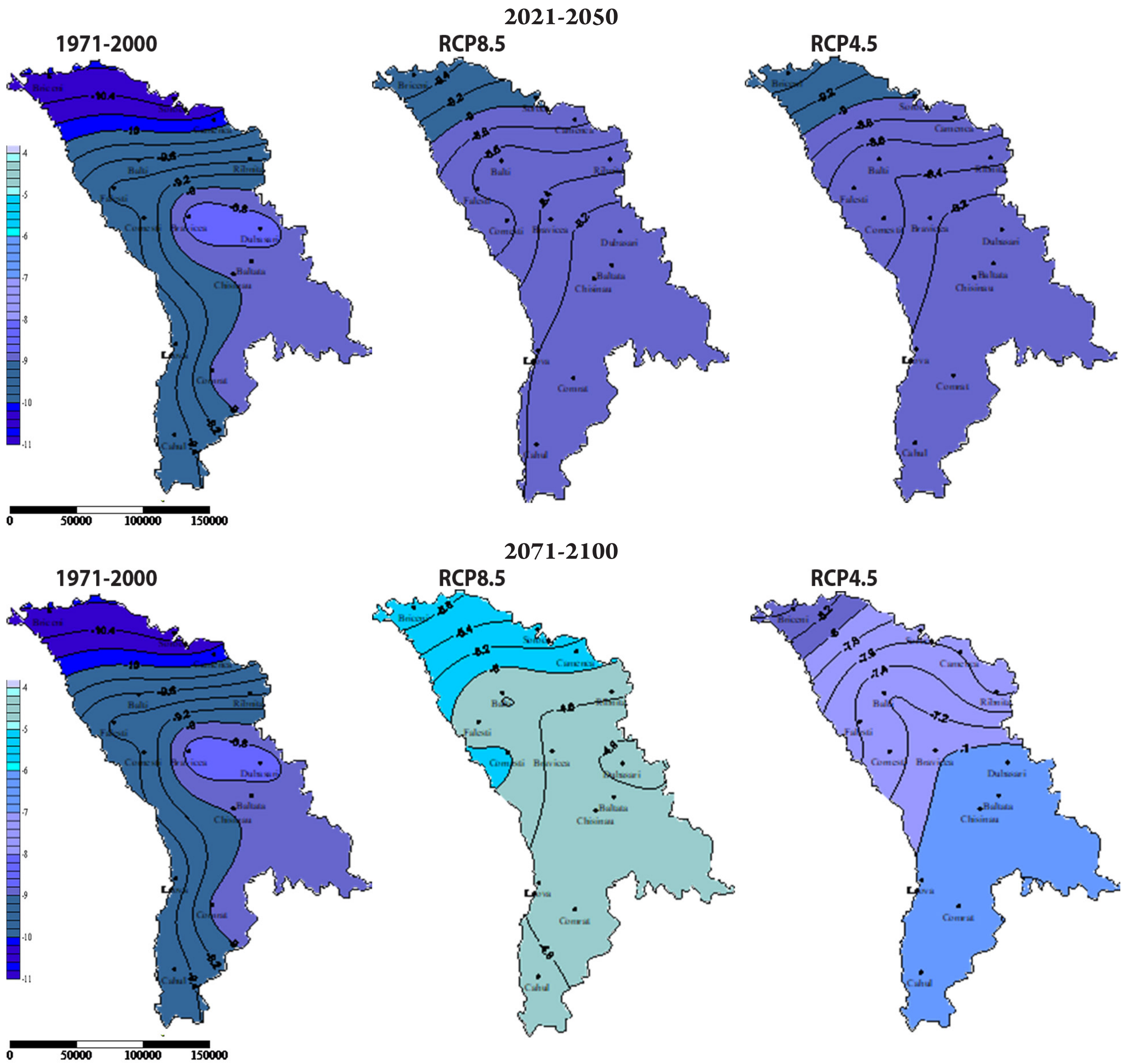


Figure 5-81: Projected Ensemble of EURO-CORDEX RCMs Normally Equivalent Effective Temperature (*NEET)* Index Development in Cold Period throughout the RM.

In comparison with the base period, 1971-2000, in 2021-2050 a differentiation in the *NEET* index is expected during the cold season, depending on the Representative Concentration Pathways, from +0.1°C to +0.6°C (RCP8.5) and/or from +0.6°C to +1.6°C (RCP4.5) in January and from +0.1°C to +1.2°C in December, in different regions of the RM.

In some districts, such as, Bravicea, Dubasari, Baltata, Falesti, Comrat, the winter conditions are getting more severe and the *NEET* index is decreasing from -0.1°C to -0.8°C, in comparison with the base period, 1970-2000. In February, for both RCPs, a maximum increase in the *NEET* index, from +1.0°C to +2.7°C, as compared to the base period, 1971-2000, is possible, **Table 5-73.**

Table 5-73: The Possible Projections of Changes in the NEET, °C, for Cold Period of Year According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Cold period of the year									
	January		February		March		November		December	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	0.3	1.0	2.1	2.2	1.5	1.3	0.7	0.4	0.5	0.4
Soroca	0.6	1.3	2.6	2.7	1.9	1.8	1.3	0.9	1.1	1.0
Camenca	0.5	1.2	2.4	2.5	1.9	1.8	1.0	0.6	0.7	0.6
Rabnita	0.1	0.8	2.0	2.1	1.5	1.4	0.7	0.3	0.4	0.3
Balti	0.4	1.1	2.4	2.5	1.8	1.7	1.0	0.7	0.6	0.5
Bravicea	-0.8	0.0	1.0	1.2	0.7	0.4	0.0	-0.3	-0.4	-0.5
Dubasari	-0.1	0.7	1.6	1.8	1.0	0.8	0.5	0.0	0.2	0.1
Baltata	-0.2	0.6	1.7	1.8	1.4	1.2	0.7	0.3	0.3	0.1
Leova	0.9	1.6	2.5	2.7	1.9	1.7	1.5	1.1	1.2	1.0
Falesti	-0.1	0.6	1.6	1.9	1.1	0.8	0.3	0.4	0.1	-0.1

Station	Cold period of the year									
	January		February		March		November		December	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
Cornesti	0.0	0.9	1.8	1.9	1.4	1.3	0.7	0.6	0.3	0.4
Chisinau	0.1	0.9	1.8	2.0	1.4	1.2	0.8	0.5	0.5	0.4
Comrat	-0.2	0.6	1.4	1.7	1.0	0.8	0.6	0.2	0.3	0.0
Cahul	0.6	1.4	2.1	2.3	1.8	1.6	1.4	1.0	1.1	0.9
2071-2100										
Briceni	5.5	2.4	6.3	3.0	5.0	2.6	3.3	1.0	4.2	1.6
Soroca	5.7	3.1	6.6	4.0	5.2	3.2	3.7	1.8	4.7	2.4
Camenca	5.6	2.7	6.5	3.7	5.3	3.2	3.5	1.5	4.3	2.1
Rabnita	5.1	1.8	5.9	2.5	4.8	2.0	3.2	0.6	4.0	1.0
Balti	5.4	2.7	6.3	3.7	5.2	3.1	3.6	1.5	4.2	1.9
Bravicea	4.0	1.4	4.7	2.2	3.9	1.8	2.5	0.6	3.1	0.9
Dubasari	4.7	2.1	5.2	2.8	4.2	2.2	3.0	1.1	3.7	1.6
Baltata	4.5	1.9	5.3	2.9	4.4	2.5	3.2	1.3	3.6	1.5
Leova	5.5	3.0	6.1	3.7	5.1	3.1	4.0	2.0	4.6	2.4
Falesti	4.9	2.0	5.6	2.6	4.4	1.9	2.9	0.9	3.7	1.1
Cornesti	5.0	2.4	5.7	3.1	4.7	2.7	3.2	1.5	3.9	1.7
Chisinau	4.9	2.3	5.5	3.0	4.5	2.6	3.3	1.4	4.0	1.8
Comrat	4.4	1.9	5.0	2.7	4.1	2.2	3.1	1.1	3.6	1.4
Cahul	5.0	2.7	5.5	3.4	4.8	2.9	3.9	2.0	4.3	2.2

During the warm period of the year (May to September) in 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, bioclimatic conditions described as "cool" (NEET = +6°C ... +12°C) are expected. The values of the NEET index will vary, on the average for the warm period, from +9.5°C in Briceni to +11.8°C in Comrat, with a maximum in Dubasari, +11.9°C, **Figure 5-82; Table 5-72.**

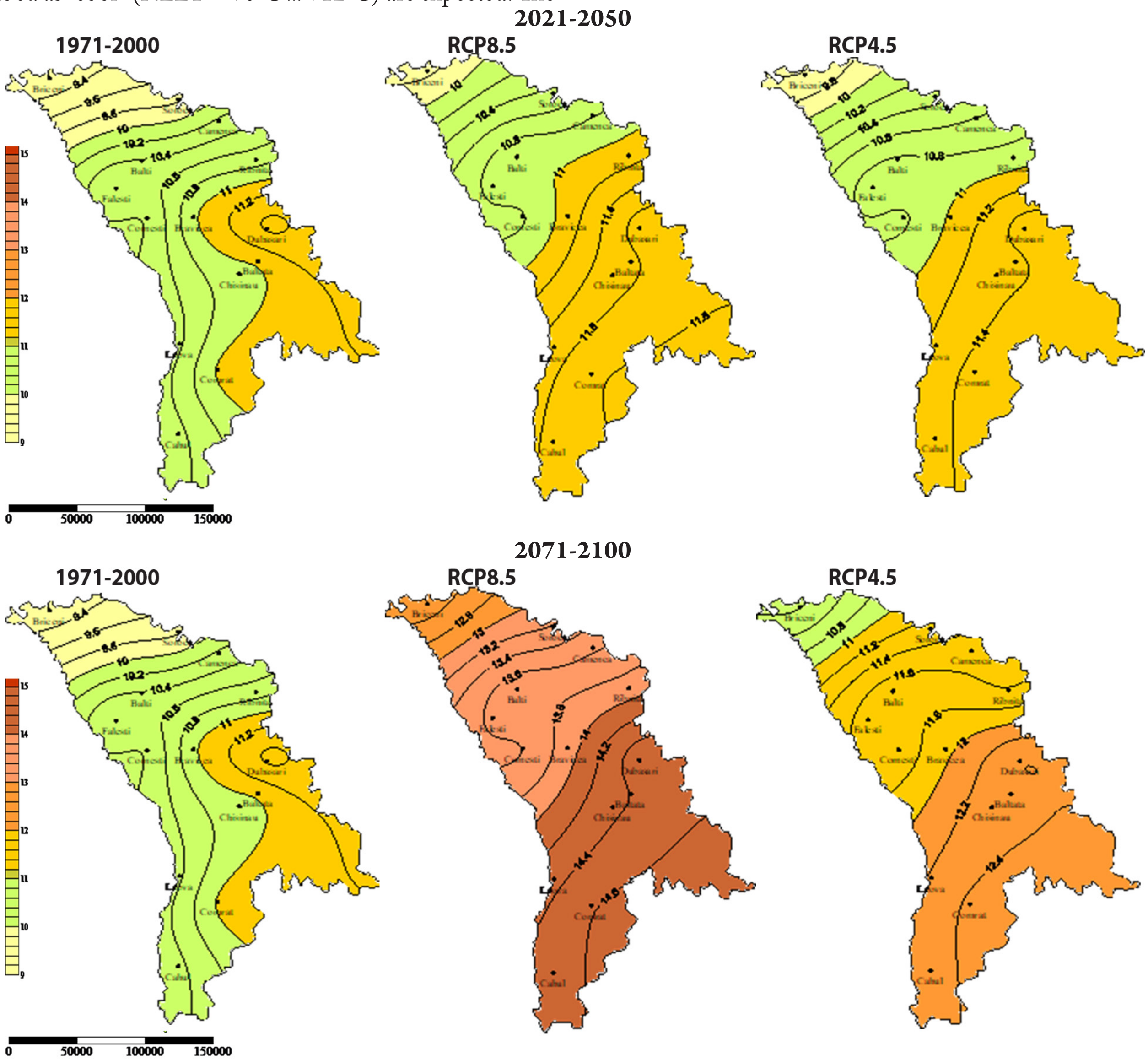


Figure 5-82: Projected Ensemble of EURO-CORDEX RCMs Normally Equivalent Effective Temperature (NEET) Index Development in Warm Period throughout the RM.

In comparison with the base period, 1971-2000, in 2021-2050 a differentiated growth of the *NEET* index over the warm period of the year (from May to September) is expected, according to both representative developmental pathways, from +0.2°C to +1.0°C in July and September in different regions of the RM. In May and June, a maximum increase in the *NEET* index, up to +1.6°C as compared to the base period, 1971-2000, is possible **Table 5-74**.

Table 5-74: The Possible Projections of the Change in the NEET, °C, for Warm Period of Year According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Warm period of the year									
	May		June		July		August		September	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	0.9	0.5	0.8	0.7	0.6	0.6	-0.1	-0.2	0.2	-0.1
Soroca	1.3	0.9	1.0	1.0	0.6	0.8	0.2	0.3	0.5	0.3
Camenca	1.2	0.8	0.8	0.7	0.3	0.3	0.0	-0.1	0.4	0.0
Rabnita	1.0	0.6	0.7	0.6	0.3	0.2	-0.1	-0.3	0.3	0.0
Balti	1.3	0.9	1.1	1.0	0.6	0.5	0.1	-0.1	0.4	0.1
Bravicea	0.4	0.1	0.3	0.3	-0.2	-0.1	-0.6	-0.7	-0.4	-0.4
Dubasari	0.5	0.1	0.4	0.3	0.0	0.0	-0.4	-0.7	-0.1	-0.3
Baltata	1.2	0.8	1.0	0.9	0.6	0.5	0.1	-0.1	0.4	0.2
Leova	1.6	1.2	1.3	1.2	0.8	0.6	0.5	0.3	1.0	0.6
Falesti	0.6	0.4	0.3	0.5	-0.1	0.0	-0.4	-0.2	-0.2	0.0
Cornesti	1.0	0.8	0.8	0.9	0.4	0.5	0.0	0.1	0.3	0.3
Chisinau	1.1	0.8	0.9	0.9	0.5	0.5	0.2	0.1	0.4	0.2
Comrat	0.9	0.5	0.9	0.7	0.5	0.2	0.2	-0.1	0.5	0.0
Cahul	1.5	1.1	1.4	1.3	1.0	0.8	0.7	0.4	1.1	0.7
2071-2100										
Briceni	3.0	1.5	3.3	1.5	3.5	1.2	3.1	0.5	3.2	0.7
Soroca	3.2	2.0	3.6	2.1	3.6	1.5	3.5	1.2	3.5	1.3
Camenca	3.3	1.9	3.5	1.7	3.3	1.0	3.2	0.8	3.3	1.0
Rabnita	3.0	1.2	3.5	1.2	3.3	0.8	3.1	0.5	3.2	0.4
Balti	3.4	2.0	3.8	2.0	3.6	1.2	3.3	0.9	3.4	1.1
Bravicea	2.5	1.2	3.0	1.3	2.8	0.6	2.6	0.3	2.6	0.5
Dubasari	2.7	1.3	3.3	1.4	3.2	0.8	2.8	0.4	2.8	0.5
Baltata	3.3	1.9	3.8	1.9	3.6	1.3	3.4	0.9	3.5	1.1
Leova	3.8	2.2	4.1	2.2	3.8	1.5	3.8	1.3	4.0	1.6
Falesti	2.8	1.4	3.1	1.3	2.9	0.6	2.7	0.6	2.8	0.6
Cornesti	3.1	1.9	3.5	1.8	3.4	1.2	3.2	1.1	3.3	1.3
Chisinau	3.3	1.9	3.7	1.8	3.6	1.3	3.4	1.0	3.4	1.1
Comrat	3.2	1.6	3.7	1.6	3.5	1.2	3.3	0.9	3.4	1.0
Cahul	3.9	2.2	4.3	2.2	4.1	1.7	3.8	1.4	4.0	1.6

Over the 2071-2100 period, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, bioclimatic conditions described as "cold discomfort" (*NEET = -18°C ... 0°C*) are expected during the cold season of the year. The values of the *NEET* index will vary during the cold period from -8.5°C (Briceni) to -6.8°C (Comrat) according to the RCP4.5 scenario and/or from -5.8°C (Briceni) to -4.7°C (Comrat) according to the RCP8.5 scenario, **Figure 5-81; Table 5-72.**

The trend towards increase in *NEET* index over the cold season will continue; it will be significantly higher for a RCP with high warming, from +1.4°C to +3.1°C (RCP4.5) and/or from +4.0°C to +5.7°C (RCP8.5) in January and from +0.9°C to +2.4°C (RCP4.5) and/or from +3.1°C to +4.7°C (RCP8.5) in December, as compared to the base period, 1971-2000, in different regions of the RM. In February, the maximum increase in the *NEET* index, from +2.2°C to +4.0°C (RCP4.5) and/or from +4.7°C to +6.6°C (RCP8.5), is expected, **Table 5-73.**

Over the warm period of the year, in 2071-2100, according to the ensemble of EURO-CORDEX RCMs, bioclimatic conditions described as "moderately warm, comfortable" (*NEET = + 2°C ... +24°C*), for the RCP8.5, are expected, while in case of the RCP4.5, on most of the territory of the RM, cooler bioclimatic conditions, described as "cool", are expected (*NEET = +6°C ... +12°C*). The values of the *NEET* index will vary depending on the RCP scenario, from +10.3°C (RCP4.5) and/or +12.4°C (RCP8.5) in Briceni to +12.5°C and/or +14.6°C in Cahul, respectively, **Figure 5-82; Table 5-72.**

The trend towards an increase in the *NEET* index of the warm season will be maintained; it will be significantly higher for the RCP with high greenhouse gas emissions, from +0.6°C to +1.7°C (RCP4.5) and/or from +2.8°C to +4.1°C (RCP8.5) in July and from +0.4°C to +1.6°C (RCP4.5) and/or from +2.6°C to +4.0°C (RCP8.5) in September, as compared to the base period, 1971-2000, in different regions of the RM. In June, a maximum increase in the *NEET* index, from +1.3°C to +2.2°C (RCP4.5) and/or from +3.0°C to +4.3°C (RCP8.5) is expected, **Table 5-74**.

5.4.5.2.5. Projections of Future Changes in Radiation-Equivalent Effective Temperature (REET)

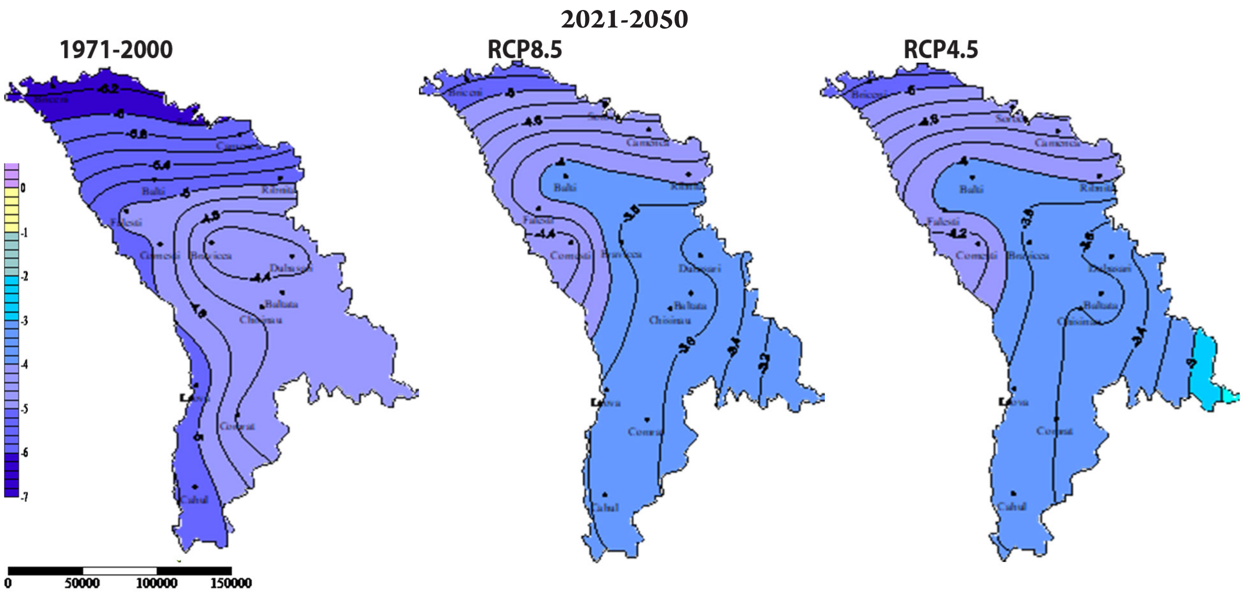
Over the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for RCPs scenarios, the thermal feelings described as "very cold" (*REET* = -8°C ... -3°C) are expected during the cold period of the year, while the REET index values will vary from -5.2°C (Briceni) to -3.6°C (Comrat), **Figure 5-83; Table 5-75.**

Table 5-75: The Projections of REET, °C, for the Cold and Warm Periods of the Year According to the Ensemble of EURO-CORDEX RCMs, under RCP8.5 and RCP4.5

Stations	1971-2000		2021-2050				2071-2100			
	Cold period of the year	Warm period of the year	Cold period of the year		Warm period of the year		Cold period of the year		Warm period of the year	
			RCP8.5	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*
Briceni	-6.3	14.3	-5.2	-5.2	14.8	14.6	-1.2	-4.1	17.6	15.4
Soroca	-6.3	14.7	-4.8	-4.7	15.5	15.4	-0.9	-3.3	18.3	16.4
Camenca	-5.9	15.4	-4.5	-4.5	16.0	15.8	-0.6	-3.1	18.9	16.7
Rabnita	-5.1	15.7	-4.1	-4.1	16.2	16.0	-0.3	-3.4	19.1	16.6
Balti	-5.2	15.6	-3.9	-3.8	16.3	16.1	-0.1	-2.5	19.2	17.0
Bravicea	-3.9	16.4	-3.8	-3.7	16.2	16.2	-0.1	-2.5	19.2	17.2
Dubasari	-4.2	17.0	-3.5	-3.5	17.1	16.9	0.1	-2.1	20.1	17.9
Baltata	-4.6	15.8	-3.8	-3.7	16.5	16.3	-0.2	-2.5	19.5	17.3
Leova	-5.4	15.6	-3.8	-3.7	16.7	16.4	-0.2	-2.5	19.6	17.4
Falesti	-4.7	16.0	-4.1	-4.0	16.1	16.2	-0.3	-2.9	19.0	17.0
Cornesti	-5.3	15.2	-4.5	-4.3	15.7	15.7	-0.7	-3.0	18.6	16.7
Chisinau	-4.6	16.1	-3.7	-3.6	16.8	16.6	0.0	-2.3	19.7	17.6
Comrat	-4.3	16.4	-3.6	-3.6	17.0	16.7	-0.1	-2.3	19.9	17.7
Cahul	-5.2	15.6	-3.8	-3.7	16.8	16.5	-0.3	-2.5	19.8	17.5

As compared to the base period, 1971-2000, in 2021-2050 a differentiated growth in the *REET* index over the cold season is expected, depending on the RCP scenario, from +0.1°C to +0.9°C (RCP8.5) and/or from +0.6°C to +1.6°C (RCP4.5) in January and from +0.1°C to +1.2°C in December, according to two scenarios in different regions of the RM. In February, a maximum increase in the *REET* index is possible, from +1.1°C to 2.8°C, as compared to the base period, 1971-2000, **Table 5-76.**

Over the warm period of the year, during the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, recreational and climatic conditions described as "moderately cool" (*REET = +12°C ... 17°C*) are expected. The values of the *REET* index will vary, on average over the warm period, from +14.6°C in Briceni to +17.0°C in Comrat, **Figure 5-84; Table 5-75**.



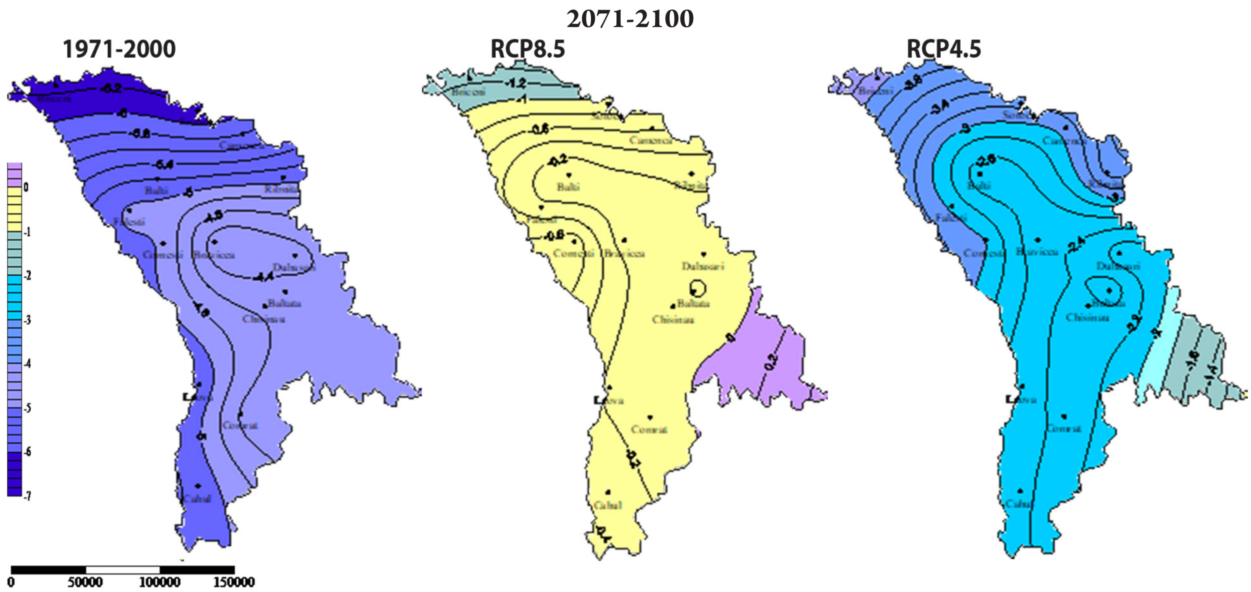


Figure 5-83: Projected Multi-Model Ensemble Radiation Equivalent Effective Temperature (*REET)* Index Development in Cold Period throughout the RM.

Table 5-76: The Possible Projections of the Change in the REET, °C for Cold Period of Year According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Cold period of the year									
	January		February		March		November		December	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	0.3	1.0	2.1	2.2	1.5	1.4	0.8	0.4	0.5	0.4
Soroca	0.6	1.3	2.7	2.8	1.9	1.9	1.4	1.0	1.1	1.1
Camenca	0.5	1.3	2.5	2.6	2.0	1.8	1.0	0.7	0.7	0.6
Rabnita	0.1	0.8	2.0	2.2	1.6	1.4	0.7	0.3	0.5	0.3
Balti	0.0	1.2	2.5	2.6	1.9	1.7	1.0	0.7	0.7	0.6
Bravicea	-0.8	0.0	1.1	1.2	0.7	0.4	0.0	-0.3	-0.4	-0.5
Dubasari	-0.2	0.7	1.6	1.8	1.1	0.8	0.5	0.0	0.2	0.1
Baltata	-0.2	0.6	1.8	1.9	1.4	1.2	0.7	0.4	0.3	0.1
Leova	0.9	1.6	2.6	2.8	2.0	1.8	1.6	1.1	1.2	1.0
Falesti	-0.2	0.6	1.7	2.0	1.1	0.8	0.3	0.4	0.1	-0.1
Cornesti	0.0	0.9	1.8	2.0	1.5	1.4	0.7	0.6	0.3	0.4
Chisinau	0.1	0.9	1.9	2.1	1.5	1.3	0.9	0.5	0.6	0.4
Comrat	-0.2	0.6	1.5	1.7	1.0	0.9	0.6	0.2	0.3	0.0
Cahul	0.6	1.5	2.2	2.4	1.9	1.7	1.5	1.0	1.1	0.9
2071-2100										
Briceni	5.7	2.5	6.6	3.1	5.2	2.7	3.4	1.0	4.4	1.7
Soroca	5.9	3.2	6.8	4.2	5.4	3.4	3.9	1.9	4.9	2.5
Camenca	5.9	2.8	6.7	3.9	5.5	3.4	3.7	1.6	4.5	2.1
Rabnita	5.3	1.9	6.2	2.6	4.9	2.1	3.3	0.6	4.1	1.0
Balti	5.6	2.8	6.6	3.8	5.4	3.2	3.7	1.6	4.4	2.0
Bravicea	4.2	1.5	4.9	2.3	4.0	1.8	2.6	0.6	3.2	0.9
Dubasari	4.8	2.2	5.4	2.9	4.3	2.3	3.1	1.1	3.9	1.7
Baltata	4.7	2.0	5.5	3.0	4.6	2.6	3.3	1.3	3.8	1.5
Leova	5.7	3.1	6.3	3.8	5.2	3.2	4.1	2.1	4.8	2.4
Falesti	5.1	2.0	5.8	2.7	4.6	2.0	3.0	0.9	3.9	1.2
Cornesti	5.1	2.5	5.9	3.2	4.9	2.8	3.4	1.5	4.0	1.8
Chisinau	5.0	2.4	5.7	3.2	4.7	2.7	3.5	1.4	4.1	1.9
Comrat	4.5	2.0	5.2	2.8	4.3	2.2	3.2	1.2	3.7	1.5
Cahul	5.2	2.8	5.7	3.5	5.0	3.0	4.1	2.0	4.5	2.3

As compared to the base period, 1971-2000, in 2021-2050 a differentiated growth is expected in the *REET* index during the warm period of the year (from May to September), according to both RCPs, from +0.2°C to +1.1°C in July and September in different regions of the RM. In May, the maximum growth in the *REET* index, from 0.5°C to +1.7°C as compared to the base period, 1971-2000, is possible, **Table 5-77.**

Over the period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, bioclimatic conditions described as "cold" (*REET* = *-3°C ... +2°C*) are expected during the cold season, while in certain districts, for the RCP4.5, bioclimatic conditions described as close to "very cold" (*REET* = *-8°C ... -3°C*) are expected. The *REET* index values will vary during the cold period from

-4.1°C (Briceni) to -2.3°C (Comrat) according to the RCP4.5 scenario and/or from -1.2°C (Briceni) to -0.1°C (Comrat) according to the RCP8.5 scenario, **Figure 5-83; Table 5-75**.

In the period 2071-2100, the trend towards an increase in the *REET* index during the cold period will be maintained; it will be significantly higher for the representative development pathway with higher warming, from +2.0°C to +3.2°C (RCP4.5) and/or from +4.2°C to +5.9°C (RCP8.5) in January and from +0.9°C to +2.5°C (RCP4.5) and/or from +3.2°C to +4.9°C (RCP8.5) in December, as compared to the base period, 1971-2000, in different districts of the RM. In February, the maximum expected growth in the *REET* index, from +2.3°C to +4.2°C (RCP4.5) and/or from +4.9°C to +6.8°C (RCP8.5), is expected, **Table 5-76.**

Over the warm period of the year in 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCP8.5 and RCP4.5 scenarios, recreational and climatic conditions described as "cool" (*REET = +17°C ... 21°C*) are expected. The values of the *REET* index will vary from +15.4°C (RCP4.5) and/or +17.6°C (RCP8.5) in Briceni to +17.7°C and/or +19.9°C, respectively, in Cahul, **Figure 5-80; Table 5-75**.

The trend towards an increase in the *REET* index during the warm period will be maintained; it will be significantly higher for a representative development pathway with high warming, from +0.7°C to +1.8°C (RCP4.5) and/or from +2.9°C to +4.2°C (RCP8.5) in July and from +0.5°C to +1.7°C (RCP4.5) and/or from +2.7°C to +4.2°C (RCP8.5) in September, as compared to the base period, 1971-2000, in different districts of the RM. In June the maximum growth of the *REET* index, from +1.3°C to +2.3°C (RCP4.5) and/or from +3.1°C to +4.5°C (RCP8.5) is expected, **Table 5-77.**

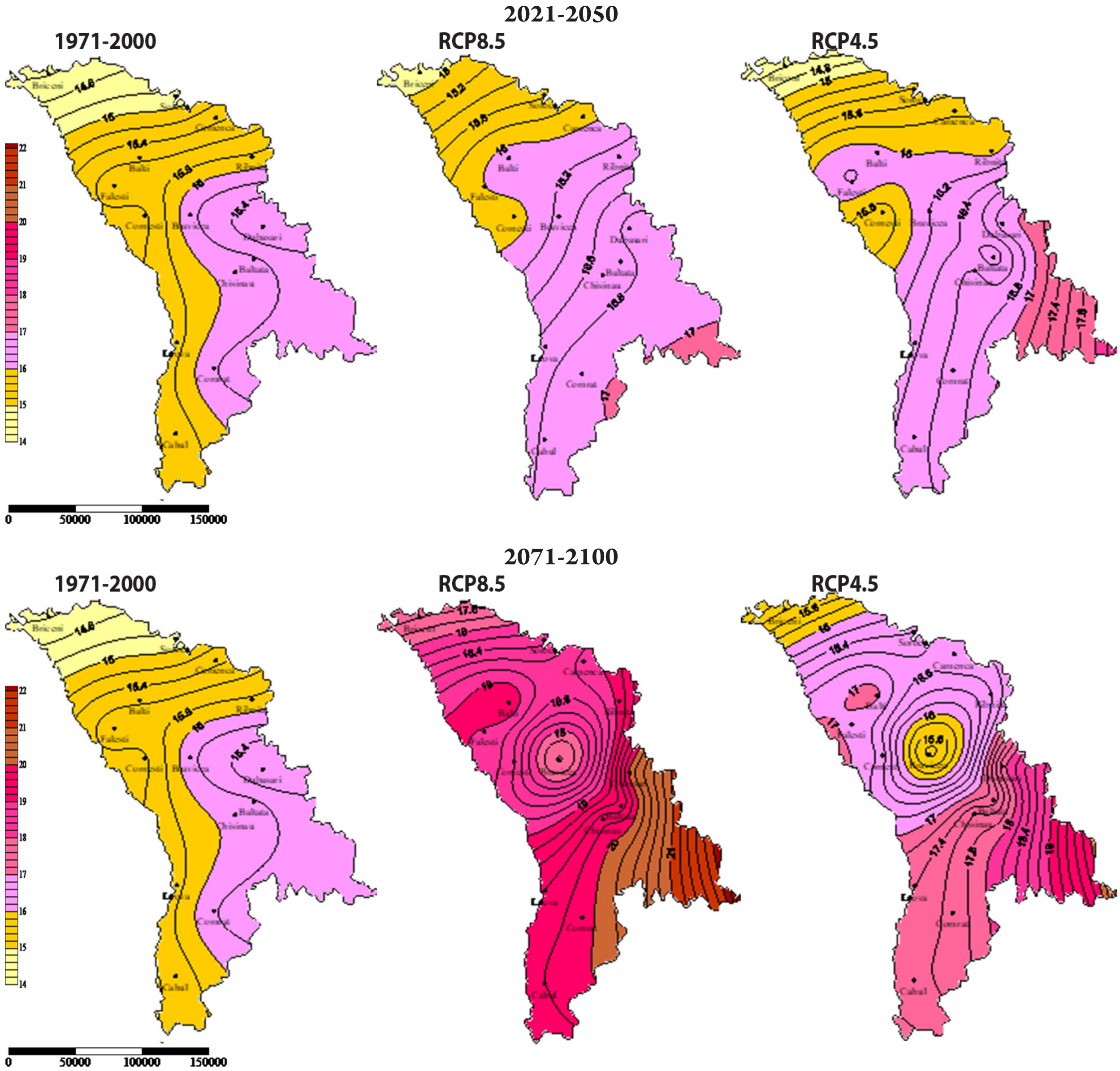


Figure 5-84: Projected Multi-Model Ensemble of EURO-CORDEX RCMs Radiation Equivalent Effective Temperature (*REET)* Index Development in Warm Period throughout the RM.

Table 5-77: The Possible Projections of the Changes in the REET, °C for Warm Period of Year According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Warm period of the year									
	May		June		July		August		September	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	1.0	0.6	0.8	0.7	0.6	0.7	-0.1	-0.2	0.2	-0.1
Soroca	1.3	0.9	1.0	1.0	0.7	0.8	0.2	0.3	0.5	0.3
Camenca	1.3	0.9	0.8	0.7	0.3	0.3	0.0	-0.2	0.4	0.0
Rabnita	1.1	0.6	0.7	0.6	0.3	0.2	-0.1	-0.3	0.3	0.0
Balti	1.4	1.0	1.1	1.0	0.6	0.5	0.1	-0.1	0.4	0.1
Bravicea	0.4	0.1	0.3	0.3	-0.3	-0.1	-0.6	-0.7	-0.4	-0.4
Dubasari	0.5	0.1	0.5	0.4	0.0	0.0	-0.4	-0.7	-0.1	-0.4
Baltata	1.2	0.8	1.1	1.0	0.6	0.5	0.1	-0.1	0.4	0.2
Leova	1.7	1.2	1.3	1.2	0.9	0.6	0.6	0.3	1.0	0.7
Falesti	0.7	0.4	0.4	0.6	-0.1	0.0	-0.5	-0.2	-0.2	0.0
Cornesti	1.1	0.9	0.8	0.9	0.4	0.5	0.0	0.1	0.3	0.3
Chisinau	1.2	0.8	1.0	0.9	0.5	0.5	0.2	0.1	0.4	0.2
Comrat	1.0	0.6	0.9	0.7	0.5	0.2	0.2	-0.1	0.5	0.0
Cahul	1.6	1.2	1.5	1.3	1.0	0.8	0.7	0.8	1.1	0.7
2071-2100										
Briceni	3.1	1.5	3.5	1.5	3.6	1.3	3.2	0.6	3.3	0.7
Soroca	3.3	2.1	3.8	2.1	3.7	1.6	3.6	1.3	3.6	1.3
Camenca	3.4	2.0	3.6	1.7	3.5	1.1	3.3	0.8	3.4	1.0
Rabnita	3.2	1.2	3.6	1.3	3.4	0.8	3.2	0.5	3.3	0.5
Balti	3.5	2.1	3.9	2.0	3.7	1.3	3.4	0.9	3.5	1.1
Bravicea	2.6	1.2	3.1	1.3	2.9	0.7	2.6	0.4	2.7	0.5
Dubasari	2.8	1.4	3.4	1.4	3.3	0.8	2.9	0.4	2.9	0.5
Baltata	3.4	1.9	4.0	2.0	3.7	1.4	3.5	0.9	3.6	1.1
Leova	4.0	2.3	4.3	2.3	4.0	1.6	3.9	1.3	4.2	1.7
Falesti	2.9	1.4	3.2	1.4	3.0	0.6	2.8	0.6	2.9	0.6
Cornesti	3.3	2.0	3.7	1.9	3.6	1.2	3.4	1.1	3.4	1.3
Chisinau	3.4	1.9	3.9	1.9	3.7	1.3	3.5	1.1	3.5	1.1
Comrat	3.3	1.6	3.8	1.7	3.6	1.2	3.4	0.9	3.5	1.0
Cahul	4.0	2.3	4.5	2.3	4.2	1.8	4.0	1.5	4.2	1.7

5.4.5.2.6. Projections of Future Changes in Biological Active Temperature (BAT)

In the 2021-2050 period, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, thermal feelings described as "severe temperature effects" (*BAT = 0°C ... +5°C*) are expected, while the values of *BAT* index will vary from +1.3°C (Briceni) to +2.6°C (Comrat), **Figure 5-85; Table 5-78.**

Table 5-78: The Projections of the BAT Index, °C, for the Cold and Warm Periods of the Year, According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5

Stations	1971-2000		2021-2050				2071-2100			
	Cold period of the year	Warm period of the year	Cold period of the year		Warm period of the year		Cold period of the year		Warm period of the year	
			RCP8.5	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*	*RCP8.5*	*RCP4.5*
Briceni	0.5	16.3	1.3	1.3	16.7	16.6	4.4	2.2	18.9	17.2
Soroca	0.5	16.7	1.7	1.7	17.3	17.2	4.6	2.8	19.5	18.0
Camenca	0.8	17.2	1.9	1.9	17.7	17.5	4.9	3.0	19.9	18.3
Rabnita	1.4	17.5	2.2	2.2	17.8	17.7	5.1	2.7	20.1	18.1
Balti	1.3	17.3	2.4	2.4	17.9	17.7	5.3	3.4	20.1	18.5
Bravicea	2.3	18.0	2.4	2.5	17.9	17.8	5.3	3.4	20.1	18.6
Dubasari	2.1	18.5	2.6	2.7	18.5	18.4	5.5	3.7	20.8	19.1
Baltata	1.8	17.6	2.4	2.5	18.1	17.9	5.2	3.4	20.4	18.7
Leova	1.2	17.3	2.4	2.5	18.2	18.0	5.2	3.4	20.5	18.8
Falesti	1.7	17.7	2.2	2.3	17.8	17.8	5.2	3.1	20.0	18.4
Cornesti	1.2	17.0	1.9	2.0	17.5	17.5	4.8	3.0	19.7	18.2
Chisinau	1.8	17.8	2.5	2.6	18.3	18.1	5.3	3.6	20.5	18.9
Comrat	2.0	18.0	2.5	2.6	18.5	18.2	5.3	3.5	20.7	19.0
Cahul	1.3	17.4	2.5	2.5	18.3	18.1	5.1	3.5	20.6	18.9

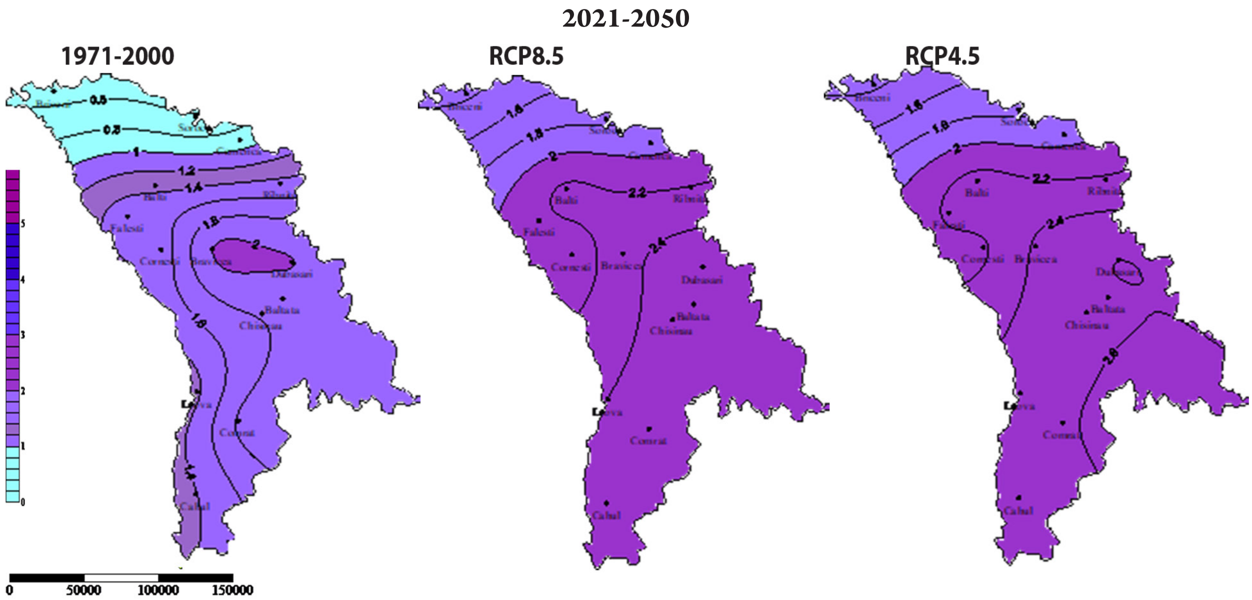
In comparison with the base period, 1971-2000, in 2021-2050 a slight increase in climate comfort is expected according to *BAT* index for the cold season, depending on the RCP scenario, from +0.1°C to +0.7°C (RCP8.5) and/or from +0.4°C to +1.2°C (RCP4.5) in January and from +0.1°C to +1.0°C in December, in different regions of the RM. In February, the maximum growth of the BAT index, from +0.8°C to +2.1°C as compared to the base period, 1971-2000, is possible, **Table 5-79**.

Table 5-79: The Possible Projections of Change in the BAT, °C for Cold Period of Year, According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Cold period of the year									
	January		February		March		November		December	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	0.3	0.8	1.7	1.7	1.2	1.1	0.6	0.3	0.4	0.3
Soroca	0.5	1.0	2.1	2.2	1.5	1.4	1.0	0.8	0.9	0.8
Camenca	0.4	1.0	1.9	2.0	1.5	1.4	0.8	0.5	0.6	0.5
Rabnita	0.1	0.6	1.6	1.7	1.2	1.1	0.6	0.3	0.4	0.2
Balti	0.3	0.9	1.9	2.0	1.5	1.3	0.8	0.5	0.5	0.4
Bravicea	-0.6	0.0	0.8	0.9	0.5	0.3	0.0	-0.3	-0.3	-0.4
Dubasari	-0.1	0.6	1.2	1.4	0.8	0.6	0.4	0.0	0.2	0.1
Baltata	-0.1	0.5	1.4	1.5	1.1	0.9	0.6	0.3	0.2	0.1
Leova	0.7	1.2	2.0	2.1	1.6	1.4	1.2	0.9	1.0	0.8
Falesti	-0.1	0.4	1.3	1.5	0.9	0.6	0.3	0.3	0.1	-0.1
Cornesti	0.0	0.7	1.4	1.6	1.2	1.1	0.5	0.5	0.2	0.3
Chisinau	0.1	0.7	1.4	1.6	1.2	1.0	0.7	0.4	0.4	0.3
Comrat	-0.2	0.5	1.2	1.3	0.8	0.7	0.5	0.1	0.2	0.0
Cahul	0.4	1.1	1.7	1.8	1.4	1.3	1.2	0.8	0.9	0.7
2071-2100										
Briceni	4.4	2.0	5.1	2.4	4.0	2.0	2.6	0.8	3.4	1.3
Soroca	4.5	2.4	5.3	3.2	4.2	2.6	3.0	1.5	3.8	2.0
Camenca	4.5	2.2	5.2	3.0	4.3	2.6	2.8	1.2	3.5	1.6
Rabnita	4.1	1.5	4.8	2.0	3.8	1.6	2.6	0.5	3.2	0.8
Balti	4.3	2.1	5.1	2.9	4.1	2.4	2.8	1.2	3.4	1.5
Bravicea	3.2	1.2	3.8	1.7	3.1	1.4	2.0	0.4	2.5	0.7
Dubasari	3.7	1.7	4.2	2.3	3.3	1.8	2.4	0.9	3.0	1.3
Baltata	3.6	1.6	4.2	2.3	3.5	2.0	2.5	1.0	2.9	1.2
Leova	4.4	2.4	4.9	3.0	4.0	2.5	3.2	1.6	3.7	1.9
Falesti	3.9	1.6	4.5	2.1	3.5	1.5	2.3	0.7	3.0	0.9
Cornesti	4.0	1.9	4.5	2.5	3.8	2.2	2.6	1.2	3.1	1.4
Chisinau	3.9	1.8	4.4	2.4	3.6	2.1	2.7	1.1	3.2	1.4
Comrat	3.5	1.5	4.0	2.2	3.3	1.7	2.5	0.9	2.9	1.1
Cahul	4.0	2.2	4.4	2.7	3.9	2.3	3.1	1.6	3.5	1.8

During the warm period of the period 2021-2050, according to the ensemble of EURO-CORDEX RCMs for both RCPs scenarios, bioclimatic conditions described as "comfortable temperature effects" (*BAT = +10°C ... 20°C*) are expected. The BAT index values will vary, on the average for the warm period from +16.6°C in Briceni to +18.5°C in Comrat, **Figure 5-86; Table 5-78**.

In comparison with the base period, 1971-2000, over the period 2021-2050 a differentiated growth of the *BAT* index for the warm period of the year (from May to September) is expected, according to both representative development pathways, from +0.1°C to +0.9°C in July and September in different regions of the RM. In May, the maximum growth of the *BAT* index, from +0.1 to +1.3°C as compared to the base period, 1971-2000, is possible, **Table 5-80**.



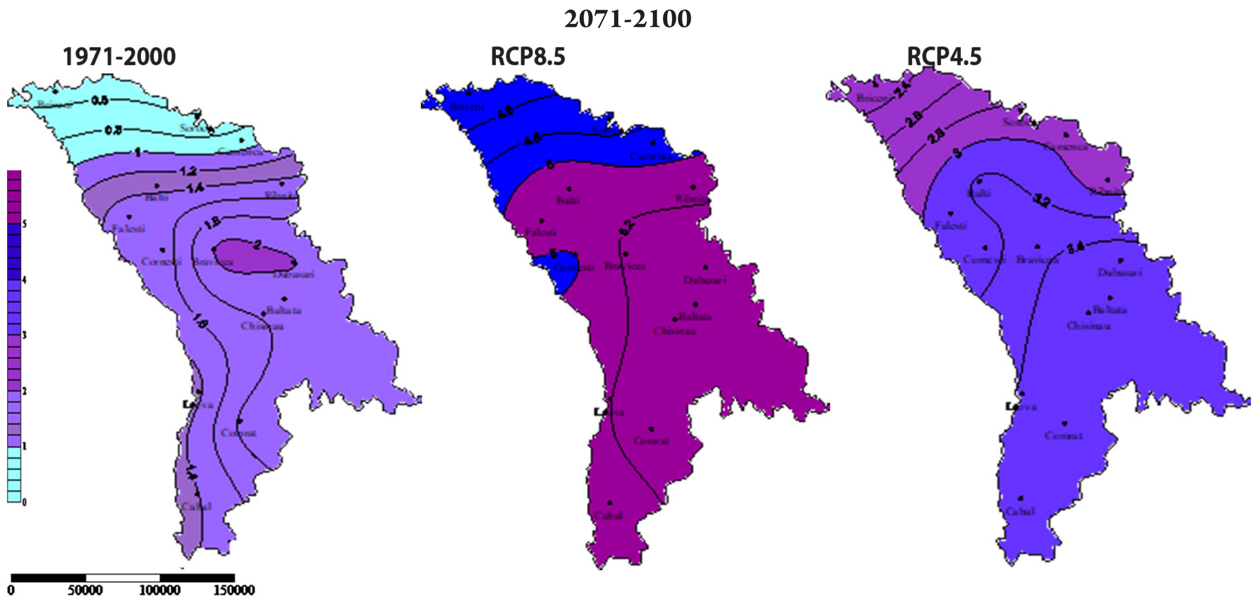
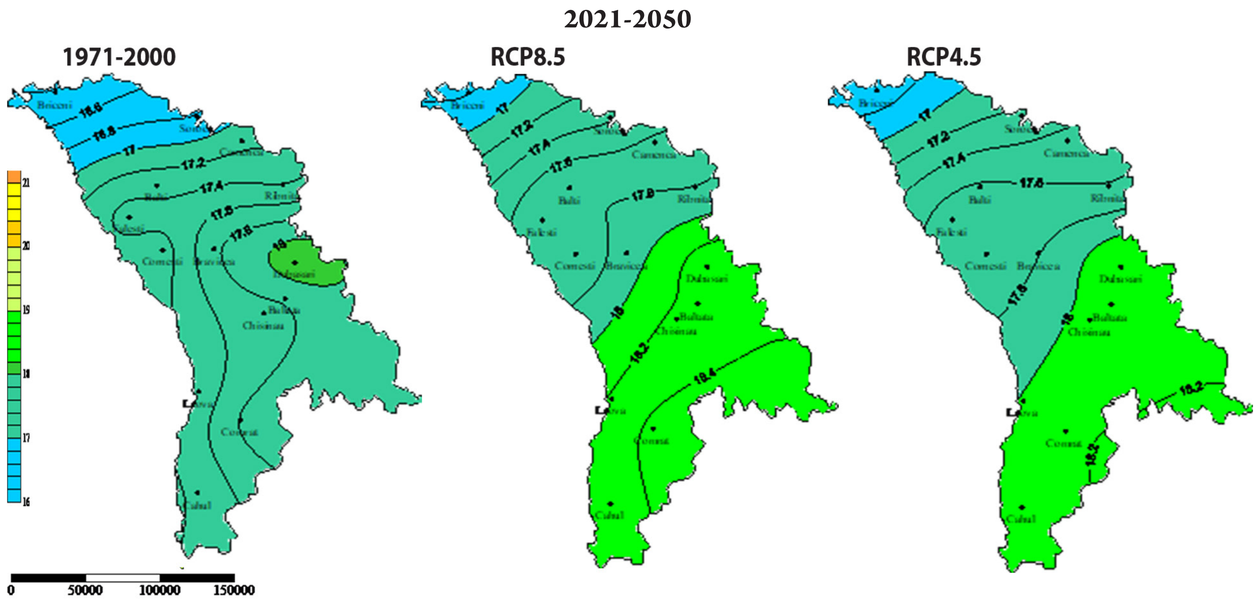


Figure 5-85: Projected Multi-Model Ensemble of EURO-CORDEX RCMs Biologically Active Temperature (*BAT) Index* Development in Cold Period throughout the RM.

In the 2071-2100 period, according to the ensemble of EURO-CORDEX RCMs for the RCP4.5 scenario, bioclimatic conditions described as "severe temperature effects" (*BAT* = 0°C ... +5°C) are expected during the cold period, while for the RCP8.5 scenario "moderate temperature effects" (*BAT = +5°C ... +10°C*) are expected. The values of *BAT* index will vary during the cold period from +2.2°C (Briceni) to +3.5°C (Comrat) according to the RCP4.5 scenario and/or from +4.4°C (Briceni) to +5.3°C (Comrat) according to the RCP8.5 scenario, **Figure 5-85; Table 5-78**.

Over the warm season of the year, during period 2071-2100, according to the ensemble of EURO-CORDEX RCMs for both RCP8.5 and RCP4.5 scenarios, recreational and climatic conditions are expected that are described as "comfortable temperature effects" (*BAT = +10°C ... +20°C*). The *BAT* index values will vary during the warm period from +17.2°C (Briceni) to +19.0°C (Comrat) according to the RCP4.5 scenario and/or from +18.9°C (Briceni) to + 20.7°C (Comrat) according to the RCP8.5 scenario, **Figure 5-86; Table 5-78**.



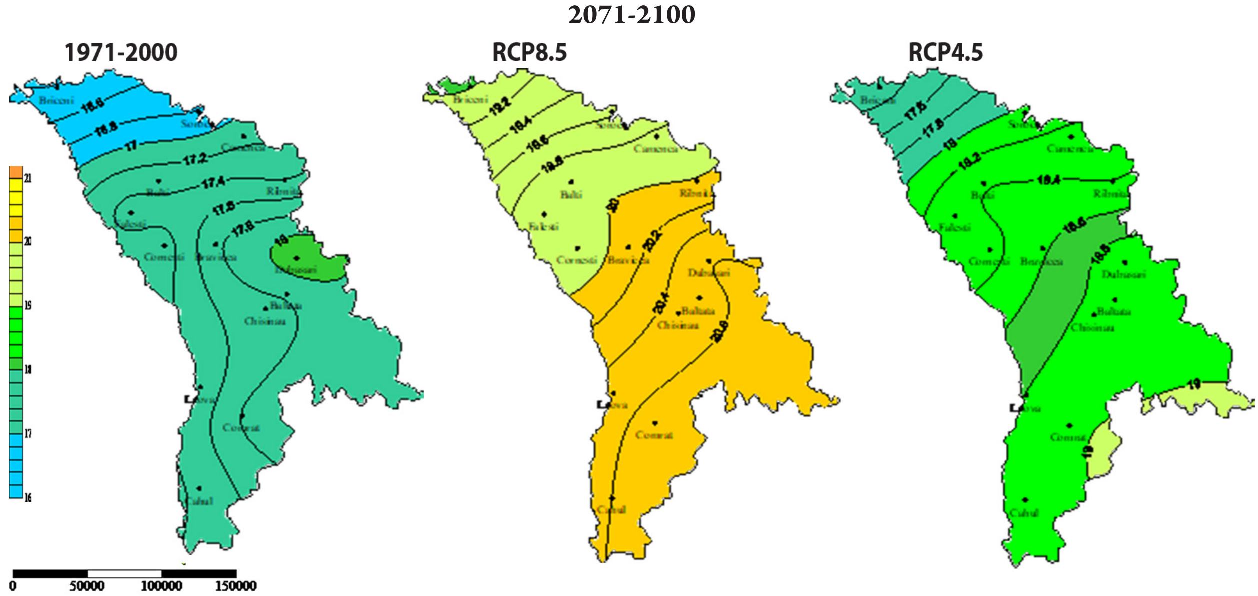


Figure 5-86: Projected Ensemble of EURO-CORDEX RCMs Biologically Active Temperature (BAT) Index Development in Warm Period throughout the RM.

The trend towards an increase in the BAT index during the warm period of the year will be maintained; it will be higher for a RCP with high warming, from +0.5°C to +1.4°C (RCP4.5) and/or from +2.3°C to + 3.5°C (RCP8.5) in July and from +0.4°C to +1.3°C (RCP4.5) and/or from +2.1°C to +3.2°C (RCP8.5) in September, as compared to the base period,1971-2000, in different districts of the RM. In June, the maximum growth of the *BAT* index, from +1.0°C to +1.8°C (RCP4.5) and/or from +2.4°C to +3.5°C (RCP8.5), is expected, **Table 5-80**.

Table 5-80: The Possible Projections of the Change in the BAT, °C for Warm Period of Year According to the Ensemble of EURO-CORDEX RCMs, under Representative Concentration Pathways RCP8.5 and RCP4.5, Relative to Reference Period, 1971-2000

Station	Warm period of the year									
	May		June		July		August		September	
	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5	RCP8.5	RCP4.5
2021-2050										
Briceni	0.7	0.4	0.6	0.6	0.5	0.5	-0.1	-0.1	0.2	-0.1
Soroca	1.0	0.7	0.8	0.8	0.5	0.6	0.2	0.3	0.4	0.2
Camenca	1.0	0.7	0.6	0.6	0.3	0.2	0.0	-0.1	0.3	0.0
Rabnita	0.8	0.5	0.6	0.5	0.3	0.2	-0.1	-0.2	0.2	0.0
Balti	1.1	0.8	0.9	0.8	0.5	0.4	0.1	-0.1	0.3	0.1
Bravicea	0.3	0.1	0.2	0.3	-0.2	-0.1	-0.5	-0.5	-0.3	-0.3
Dubasari	0.4	0.1	0.3	0.3	0.0	0.0	-0.3	-0.5	0.0	-0.3
Baltata	1.0	0.6	0.8	0.8	0.4	0.4	0.1	-0.1	0.3	0.1
Leova	1.3	0.9	1.0	0.9	0.7	0.5	0.4	0.3	0.8	0.5
Falesti	0.5	0.3	0.3	0.4	0.0	0.0	-0.3	-0.1	-0.1	0.0
Cornesti	0.8	0.7	0.6	0.7	0.3	0.4	0.0	0.1	0.2	0.2
Chisinau	0.9	0.6	0.7	0.7	0.4	0.4	0.2	0.1	0.3	0.2
Comrat	0.7	0.4	0.7	0.6	0.4	0.2	0.2	-0.1	0.4	0.0
Cahul	1.2	0.9	1.1	1.0	0.8	0.6	0.6	0.3	0.9	0.5
2071-2100										
Briceni	2.4	1.2	2.7	1.2	2.8	1.0	2.5	0.4	2.6	0.6
Soroca	2.6	1.6	2.9	1.6	2.9	1.2	2.8	1.0	2.8	1.0
Camenca	2.6	1.6	2.8	1.3	2.7	0.8	2.6	0.6	2.7	0.8
Rabnita	2.4	1.0	2.8	1.0	2.6	0.6	2.5	0.4	2.6	0.4
Balti	2.7	1.6	3.0	1.6	2.9	1.0	2.6	0.7	2.7	0.8
Bravicea	2.0	0.9	2.4	1.0	2.3	0.5	2.0	0.3	2.1	0.4
Dubasari	2.2	1.1	2.6	1.1	2.5	0.6	2.2	0.3	2.2	0.4
Baltata	2.6	1.5	3.1	1.5	2.9	1.0	2.7	0.7	2.8	0.9
Leova	3.1	1.8	3.3	1.8	3.1	1.2	3.0	1.0	3.2	1.3
Falesti	2.2	1.1	2.5	1.1	2.3	0.5	2.2	0.4	2.2	0.5
Cornesti	2.5	1.5	2.8	1.5	2.8	0.9	2.6	0.9	2.6	1.0
Chisinau	2.6	1.5	3.0	1.5	2.9	1.0	2.7	0.8	2.7	0.9
Comrat	2.5	1.3	2.9	1.3	2.8	1.0	2.6	0.7	2.7	0.8
Cahul	3.1	1.7	3.5	1.8	3.3	1.4	3.1	1.2	3.2	1.3

5.4.6. Potential Impact of Climate Change on Health

5.4.6.1. Summary of Observed Climate Impacts on Health in the RM

The extreme events related to climate change are the heat and cold waves, droughts, landslides, torrential rains and floods. Climate change affects all the development areas of a state. Its effects are not limited to a single sector. At national level, agriculture is the most affected sector; however, the impact on the health sector is also significant, and measures are needed to increase the resilience of the sector to meet the new challenges caused by extreme weather events conditioned by climate change.

Climate change and extreme climate events have a direct and indirect impact on health. Frequently, the effects arising from the impact in some sectors have an impact on other sectors. At the same time, extreme events can affect agriculture, forestry and industry, thus causing food security problems and poor sanitation, which, in their turn, can lead (indirectly) to serious impact on health in the short and long term.

It is necessary to investigate different aspects of climate variability, as it influences differently the health of the population. The high and low temperature of ambient air causes different natural focal diseases. The reaction of the human body is different at temperature variations. The thermal extremes (maximum and minimum temperature) both during the daytime and during the night have more pronounced effects on the population. Thermal extremes have a different impact on health in different seasons. Extremely high temperatures affect the urban population to a greater extent. The changes in the body are also different when the air temperature is combined with relative air humidity and wind speed.

The state of health of the human body is influenced by the lack of precipitation and abundant precipitation of short and long-term duration. Lack of rainfall or a reduction in the amount of seasonal rainfall is dangerous to agriculture, which indirectly poses health hazards through malnutrition, unsafe food. Abundant precipitation leads to floods that affect housing, living conditions, and contribute to increase in vector-borne diseases.

Each of these climatic variables requires a different level of qualification in terms of climate modelling and has varying degrees of predictability as related to climate change, such data being essential for building climate scenarios.

Shocks associated with extreme weather events or the accumulation of a series of events or a prolonged event (for example - high temperatures, low temperatures, floods, droughts) can lead to stress. Risk assessment requires the transition from description of extremes to description of hazards.

Climate hazards are events and combinations of events that can cause damage to health and living conditions. Depending on the adopted approach, the hazards (risks) can be described in two ways: (1) the approach based on natural hazards, where the focus is on the climate hazard itself, and (2) the vulnerability-based approach that highlights the damage caused by a hazard.

The approach based on natural hazards is to establish a level of risk, such as the peak wind speed, the extreme temperature threshold, at which the changes in the health condition increase the vulnerability, either in space or in time. Different social groups will show different degrees of vulnerability depending on their physical condition and on their socio-economic capacity.

The vulnerability-based approach allows establishing criteria according to the level of hazard and its magnitude. Climate change does not lead to the emergence of new ways of action by the environment, but tends to exacerbate the effect of environmental determinants of climate-conditioned health. The following hazards can be recorded as the likely consequences of climate change:

- Increase in the number of intestinal infections, which have a considerable seasonal incidence, with regular registration in many countries over the last few years;
- Resurgence of some diseases (malaria, yellow fever, etc.);
- Pronounced fluctuation of daily and weekly morbidity;
- Change in the nature and level of hospitalization in conditions of warmer summers, milder winters and a more flexible regional climate;
- Changes in qualitative and quantitative assessments of trauma and morbidity projections [Opopol N., Nicolenco A., 2004].

The impact assessment of current climate can be used to determine how a climatic hazard acts on society, or to examine vulnerability, while finding out the climatic hazards involved. Impact can be assessed by qualitative and quantitative methods. Out of the extreme events, associated with climate change, extreme temperatures have the most pronounced and obvious influence on the population. The impact assessment of events and the assessment of extreme events variability can be achieved by the statistical analysis of relatively short historical data. Thus, we conducted a study of the number of deaths (2001-2010) and EMS calls (2007-2010) in Chisinau municipality. The study provided an analysis of periods of extreme high and low temperatures (according to the methodology outlined in Chapter 1). During the summer of 2007, the number of extremely hot days caused by the apparent temperature was very high in the RM and it had increased over the period July-August up to 20 days (Overcenco A., Pantea V., 2012). The apparent temperature values in the summer of 2007 have reached the first degree of precaution when fatigue can occur due to sun exposure and prolonged physical activity, while continued activity under such conditions could lead to heat cramps. The persistent warm weather, which has settled for a long time, has contributed to the accumulation of heat and consequently has led to an increase in the number of days with discomfort (Croitoru C., Overcenco A., Pantea V., Opopol N., 2015).

The results of the research carried out during the hot period of 2007 showed that 191 cases of excess deaths were recorded in Chisinau municipality, including during the summer - 164 cases of excess deaths corresponding to 25 cases and 22 cases, respectively, in 100,000 inhabitants. The share of excess deaths (as compared to RP) is obviously higher in summer (11.3%) than in the warm period (6.4%), **Table 5-81**.

Table 5-81: Cases of Deaths and EMS Calls during Periods of Extreme Temperatures in Chisinau Municipality (as Compared to *Total number of cases*), abs

Periods	Indicators	Total number of cases, abs	Total number of cases in 100,000 inhabitants	Number of excess cases, abs	Number of excess cases in 100,000 inhabitants	Number of excess cases, %
Deaths						
Warm period	2007	3,176	407	191	25	6.4
	RP	2,985	382			
Summer	2007	1,613	207	164	22	11.3
	RP	1,449	185			
Cold period	2002/2003	2,796	358	12	1,5	0.4
	2005/2006	2,790	358	-39		
	2009/2010	2,857	364	28	2	1.0
	RP	2,829	362			
Winter	2002/2003	1,730	222	5	1	0.3
	2005/2006	1,733	222	40	6	2.3
	2009/2010	1,751	223	58	6	3.4
	PR	1,693	217			
EMS calls						
Warm period	2007	113,573	14,555	-8,753		
	RP	122,326	15,637			
Summer	2007	58,009	7,434	-4,177		
	RP	62,186	7,949			
Cold period	2009/2010	128,527	16,353	25,075	3,113	24.2
	RP	103,452	13,240			
Winter	2009/2010	78,015	9,926	16,036	1,803	22.9
	RP	61,979	8,123			

The graph in **Figure 5-87** shows the influence of high temperatures on the number of excess deaths in the hotter year of 2007. It can be seen that the number of deaths increases within a few days after the action of high temperatures.

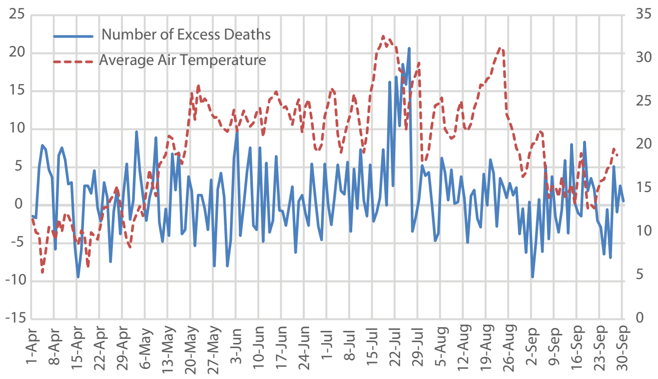


Figure 5-87: Number of Excess Deaths and Average Air Temperature Values in Chisinau During the Warm Period of 2007.

The cold waves conducted to a lower number of excess deaths, as compared to the heat wave. There were 12 cases during the cold period of 2002/2003 and 28 - during the same period of 2009/2010, which is 0.4-1.0% more than during the reference period. More excess deaths were recorded during the winter months of 2005/2006 (40 excess deaths) and of 2009/2010 (58 excess deaths), **Table 5-81**. The deaths at the end of January 2006 were preceded by a period of minimum temperatures between minus 17 and 24°C, while those in the first half of February - about minus 17°C. During 2009/2010, several periods of excess deaths were recorded: mid-December, end of January, first half of February and mid-March. During this period, two cold waves were recorded, one in mid-December, with the minimal temperature of minus 16-17°C and the second – in the second half of January with minima of minus 20-21°C, which preceded the excess deaths registered during these periods.

Calls for emergency medical service were reviewed for 2007-2010, a time span including a warm period (2007) and a cold period (2009/2010). Since the reference period is short, it is difficult to record certain specific issues. During the warm period (April-September) of 2007 in Chisinau, a number of 113,573 (14,555 in 100,000 population) EMS calls were registered; of them 58,009 (7,434 in 100,000 population) EMS calls were recorded during three months of the same year. During the high air temperatures, there were no additional EMS calls, probably due to the fact that the summer of 2010 was also included in the reference period, that summer being also particularly hot, **Table 5-81**.

Over the cold 2009/2010 period, a number of 128,527 (16,353 in 100,000 inhabitants) EMS calls were registered, including 78,015 (9,926 in 100,000 inhabitants) EMS calls during the winter months. Low temperatures have caused additional EMS calls; during the cold season 25,075 excess EMS calls were registered, which means 3,113 cases in 100,000 inhabitants, while during cold winter of 2009/2010 a number of 16,036 (1,803 in 100,000 inhabitants) excess EMS calls were recorded. The average number of daily EMS calls over the winter of 2009/2010 was 866 ± 16 in 100,000 inhabitants with a statistically significant difference ($p<0.001$) as compared to the reference period. The share of additional EMS calls in winter accounted for 22.9% as compared to RP, while during the cold season it was higher - 24.2% as opposed to RP, **Tables 5-81** and **5-82**.

Table 5-82: Statistical Evaluation of EMS Calls During the Particularly Cold Winter of 2009/2010

Indicators	2009/2010	RP
Number of EMS calls	78,015	61,979
Number of EMS calls in 100,000 inhabitant	9,926	8,123
Simple arithmetic average (M)	866.8	705
Standard deviation (σ)	149	78.8
Error of the simple arithmetic average	15.8	8.4
Student criterion (t)	9.05	
Level of statistical significance (p)	0.000	

By analyzing the number of deaths by place of residence, a greater number of deaths are found in the urban area, which is also confirmed by the literature data; urban areas have the "heat islands", formed by accumulation of heat, larger paved areas (Opopol N, Nicolenco A., 2004; Vanos J., et al., 2014).

During the warm season of 2007, a number of 2,743 EMS calls were recorded in Chisinau; of them 94.5% were registered in summer (2,591 deaths). Comparison with the reference period shows a number of 153 excess deaths, **Table 5-83**.

Table 5-83: Deaths During Periods of Extreme Temperatures in Chisinau *by Residence and Gender*

Periods/ Indicators		Urban area		Rural area		Men		Women	
		total	excess	total	excess	total	excess	total	excess
Warm period	2007	2,743	153	434	38	1,710	90	1,466	101
	RP	2,591		396		1,620		1,365	
Summer	2007	1,391	153	222	34	862	68	751	96
	RP	1,262		188		794		655	
Cold period	2002/2003	2,391	14	450	-6	1,552	44	952	-32
	2005/2006	2,305	-76	487	30	1,501	-7	1,289	-32
	2009/2010	2,553	176	306	-150	1,522	14	1,335	14
	RP	2,378		456		1,508		1,321	
Winter	2002/2003	1,429	11	269	-11	1,289	41	746	-36
	2005/2006	1,414	-6	317	39	941	30	792	10
	2009/2010	1,561	143	188	-91	929	18	822	40
	RP	1,418		280		911		782	

The fact is also confirmed by the correlation coefficient between the number of EMS calls and air temperature, which, while showing a low correlation ($0.272<r<0.201$), it is still statistically significant ($p<0.05$), **Table 5-84**.

Mortality during the cold waves was different for the three investigated periods. A large number of excess deaths was recorded only in the urban area during both the winter of 2009/2010 (145 excess deaths) and generally during the cold period of the same year (176 excess deaths). During the cold period of 2002/2003, 14 excess deaths were registered, including 11 excess deaths during winter months in urban areas. In 2005/2006, excess deaths were recorded only in the rural area of Chisinau. And, even though during the same year the total number of deaths was higher during the cold period (487 deaths) than during winter months (317 deaths) of the same year, the number of excess deaths was higher in winter (39 excess deaths in winter as opposed to 30 excess deaths for the cold period), **Table 5-83**. Thus, the higher number of deaths during the period 2009/2010 as compared to period 2005/2006 may be due to lower average and minimal air temperatures in 2009/2010 (*T mean* = -2.7°C, *T min* = -5,1°C as compared to *T mean* = -2,1°C, *T min* = -4,6°C in 2005/2006 (in Chisinau municipality. However, the influence of low temperatures in 2002/2003 is not confirmed (*T mean* and *T min* were identical to those of 2009/2010).

The **Table 5-83,** shows the number of deaths by gender. According to the total number of deaths, men are more sensitive to both heat and cold. In 2007, under the influence of heat, 244 more men died than women (1,710 as opposed to 1,466 deaths) ($p\leq0.01$). In 2002/2003, under the influence of cold, 600 more men died than women, while in 2005/2006 - 212 more men died than women, and in 2009/2010 - 187 more men died ($0.001\leq p\geq0.05$). However, it is noticeable that this is also common for the reference periods. Thus, if we look at the number of excess deaths, we get a contradictory result: at high temperatures men are more resistant, while women are more sensitive. This is shown by the higher number of deaths in women (during the warm period of 2007 – there were 101 more excess deaths in women, while during the summer months of 2007 there were 96 excess deaths in women as compared 90 and 68 excess deaths, respectively, in men). During the winter months, we can see that men and women react roughly in the same way, because in the winter of 2009/2010 more women died (40 excess deaths in women, as compared to 8 excess deaths in men). However, the low temperatures of 2002/2003 and 2005/2006 have caused a higher number of excess deaths in men (41 excess deaths in men compared to lack of excess deaths in women and, respectively, 30 excess deaths in men as opposed to 10 excess deaths in women).

In **Table 5-84**, the regression analysis of death dependence on thermal conditions of the cold season shows poor but statistically reliable correlations for men and for the population with age under 60. Daily maximum temperatures have a bigger impact (r=-0,212 for men and r=-0,246 for people under 60). Thus, when the maximum daily temperature decreases by 1°C, the number of deaths in men is expected to increase by 0.07, while in the category of population with age below 60 - by 0.06. The somewhat weak correlation between mortality and temperature, partly explained by relatively mild temperature conditions of the cold season in the RM, highlights the need to study the impact of winters.

Table 5-84: Linear Regression Parameters of the Number of Deaths at Mean, Maximum and Minimum Temperatures During the Cold Period of the Year (2001-2010)

Categories of population	Mean temperature			Maximal temperature			Minimal temperature		
	r	b	p-value	r	b	p-value	r	b	p-value
Men	-0.07	-0.202	0.013	-0.07	-0.212	0.009	-0.07	-0.195	0.017
Women	-0.01	-0.048	0.558	0.01	-0.005	0.579	-0.01	-0.049	0.550
< 60	-0.06	-0.207	0.011	-0.06	- 0.246	0.002	-0.05	- 0.163	0.045
> 60	-0.02	-0.066	0.419	-0.01	- 0.044	0.587	-0.04	-0.095	0.248

Note: *Shaded cells show statistically relevant data with 90-95% confidence level*

Regarding the place of residence, the assessment of the number of EMS calls, which are influenced by high temperatures, shows higher values in urban areas and in women. However, the number of EMS calls is higher in the urban area and in women both in the warm period of 2007 and in the reference period, so no excess EMS calls are recorded. The lower number of EMS calls in the rural area may be conditioned by climatic events only indirectly, as the access of the rural population to emergency medical services is limited, due to the limited technical possibilities of providing emergency assistance in the suburbs, especially during winter.

In 2007, the number of EMS calls in the urban area was 99,411 calls, while in the rural area – 8,339 EMS calls; during the summer months, 51,182 EMS calls were recorded in the urban area and 4,051 cases - in the rural area of the municipality, **Table 5-85**.

The number of EMS calls during the 2009/2010 cold surges was also higher in the urban area, both for the total number of calls and the number of excess calls. In the urban area of Chisinau municipality (which includes a much larger number of inhabitants than in the rural area of the municipality), the number of excess EMS calls was 22,238 as compared to 2,216. Over the winter months, the number of additional EMS calls in the urban area was 14,805, while in the rural area - 979 cases. According to the number of cases of additional EMS calls, there were 1,400 more EMS calls for women than for men (13,238 women as compared to 11,838 men) during the cold period of 2009/2010 (as compared to the reference period). Over the winter months, there were 868 more excess EMS calls in women than in men (8,452 in women as opposed to 7,584 in men), **Table 5-85**.

Table 5-85: EMS Calls in 2009/2010 in Chisinau (by Residence and Gender), abs

Periods/ Indicators		Urban area		Rural area		Men		Women	
		total	excess	total	excess	total	excess	total	excess
Warm period	2007	99,411	-2,359	8,339	-3,917	46,254	-4,181	67,319	-4,572
	RP	101,770		12,256		50,435		71,891	
Summer	2007	51,182	-339	4,051	-2,179	23,634	-2,235	34,375	-1,942
	RP	51,521		6,230		25,869		36,317	
Cold period	2009/2010	108,689	22,238	11,656	2,216	53,818	11,838	74,709	13,238
	RP	86,451		9,440		41,981		61,471	
Winter	2009/2010	66,518	14,805	6,581	976	32,670	7,584	45,345	8,452
	RP	51,713		5,606		25,086		36,893	

Women make for more EMS calls than men, both in total number of EMS calls and in excess EMS calls. Of the total number of EMS calls, women addressed for EMS services more frequently than men (during the warm period of 2007 a number of 67,319 women applied for EMS as compared to 46,254 men, while during the summer months 34,375 women as compared to 23,634 men requested EMS, an about 20% difference, **Table 5-85**. The correlation coefficient shows the relation of EMS calls in women with mean, maximum and minimal temperatures ($0.301<r<0.268$), with a high degree of statistical significance ($p<0.001$), the stronger correlation being with the mean and maximum temperatures. EMS calls for men correlate significantly only with mean and maximum temperatures, with a low correlation ($0.261<r<0.235$) and a low regression coefficient ($1.40<b<1.87$), **Table 5-86**.

Table 5-86: Linear regression parameters in EMS calls at mean, maximum and minimum temperatures in the summer of 2007

Categories of population	Mean temperature			Maximal temperature			Minimal temperature		
	r	*b*	*p-value*	*r*	*b*	*p-value*	*r*	*b*	*p-value*
Urban	0.272	4.83	0.009	0.267	3.92	0.010	0.201	4.35	0.054
Rural	-0.057	-0.38	0.601	-0.014	-0.08	0.895	-0.078	-0.62	0.469
Men	0.261	1.87	0.012	0.235	1.40	0.024	0.165	1.44	0.116
Women	0.301	3.21	0.004	0.288	2.54	0.005	0.268	3.48	0.009

Note: *Shaded cells show statistically relevant data with 90-95% confidence level.*

Upon analysis of the total number of deaths during the winter of 2009/2010, women appear to be more vulnerable to thermal conditions than men, more women applying for emergency medical services (5,772 women in 100,000 population versus 4,159 men in 100,000 population); however, during the reference period, more EMS calls were made on behalf of women (4,774 women in 100,000 population versus 3,314 men in 100,000 population), with a statistically significant difference between the study period and the reference period ($p<0.001$). In the daily average data for the 2009/2010 winter period there is a significant difference between EMS calls made on behalf of women (64.1 in 100 thousand ± 1.0) and on behalf of men (46.2 in 100 thousand ± 1.1) ($p<0.001$). However, when the weights are calculated, the opposite is noticeable, that women are more resistant to low temperatures because in the particularly cold winter of 2009/2010 more women (by 39%) than men applied for EMS as compared to the reference period, when 44% more women applied for EMS services than men, **Table 5-87**.

Table 5-87: Number of Daily EMS Calls in Chisinau Under Impact of Low Temperatures

Categories of population		Total for winter period		Monthly mean		Daily mean	
		2009/2010	RP	2009/2010	RP	2009/2010	RP
Men	abs.	32,670	25,086	10,890	10,697	363	289
	in 100 thousand	**4,159**	**3,197**	**1,386**	**1,364**	**46**	**37**
Women	abs.	45,345	36,893	15,115	12,482	504	416
	in 100 thousand	**5,772**	**4,703**	**1,924**	**1,591**	**64**	**53**

The highest number of deaths influenced by low temperatures was recorded in people over 60 in all studied periods. This fact has immediate connection with the diseases associated with advanced age, but at the same time the major influence of the high temperatures in this population group (by increased number of excess deaths) is noticeable, with more deaths registered in 2007 as compared to the reference period. Over the warm period of 2007, there were 121 cases of excess deaths in people aged over 60, and 57 excess deaths in people aged 40 to 59, a number of 27 excess deaths in the 18-39 age group. For the summer period, the same structure is noticeable, but the number of excess deaths in the over 60 age group is even higher than in the warm period - 128 cases, which again shows an increase in the sensitivity to the effects of high temperatures with age, **Table 5-88**.

During the cold periods of the year, more deaths are reported for people aged over 60; however, more deaths in this population group were recorded only in 2009/2010: during the cold period - 95 cases and 80 cases in winter. During the 2002/2003 cold season there were excess deaths in children (12 cases), in people aged 18-39 (13 cases) and in persons over 60 (10 cases), while during the winter of the same year 5 excess deaths in children and 7 excess deaths in people aged 40 to 59 were registered. During the cold period of 2005/2006, excess deaths were recorded only within the 18-39 age group (16 cases), while during the winter of the same year in the 18-39 age group (15 cases) and 40-59 years (47 cases) were found, **Table 5-88**.

Table 5-88: Cases of Deaths and EMS Calls During Periods of Extreme Temperatures in Chisinau Municipality (*by age groups*), abs

Periods/ Indicators		Age 0-17		Age 18-39		Age 40-59		Aged over 60	
		Total	Excess	Total	Excess	Total	Excess	Total	Excess
Deaths									
Warm period	2007	47	-14	230	27	888	57	2,009	121
	RP	61		203		831		1,888	
Summer	2007	18	-14	113	8	449	42	1,033	128
	RP	32		105		407		905	
Cold period	2002/2003	57	12	188	13	783	-22	1,813	10
	2005/2006	39	-6	191	16	799	-6	1,761	-42
	2009/2010	35	-10	141	-34	783	-22	1,898	95
	RP	45		175		805		1,803	
Winter	2002/2003	31	5	100	-5	491	7	1,076	-2
	2005/2006	26	0	120	15	529	47	1,056	-22
	2009/2010	22	-4	85	-20	487	3	1,155	80
	RP	26		105		484		1,078	
EMS calls									
Warm period	2007	22,685	-6,686	31,431	-1768	29,681	1,408	29,776	-1,706
	RP	29,371		33,199		28,273		31,482	
Summer	2007	12,023	-3,616	16,606	-612	15,051	825	14,329	-774
	RP	15,639		17,218		14,226		15,103	
Cold period	2009/2010	34,469	13,723	37,738	-207	27,569	4,054	28,751	-24,663
	RP	24,016		27,776		24,697		26,963	
Winter	2009/2010	21,525	7,352	22,202	5,840	16,844	1,717	17,444	1,128
	RP	14,173		16,362		15,127		16,316	

The structure of EMS calls by age groups shows a different pattern than that of deaths, which is associated with extreme temperature effects. High temperatures caused additional EMS calls only in the 40-59 age group (1,408 – during the warm period of 2007 and 825 - during summer of 2007 as compared to RP ($0.001 \leq p \geq 0.01$)). The quantitative estimation of the impact of ambient temperatures on the number of EMS calls by linear regression allowed determining the dependence of different age groups on weather conditions. The data of Table 5-89 confirms the positive sub-mean correlation between air temperature values and the 18-39 age group with a high degree of confidence ($0.431 < r < 0.454$, $p < 0.001$). The EMS calls of the other age groups show a very low correlation and in most cases are statistically insignificant, **Table 5-89**.

Table 5-89: Linear Regression Parameters of EMS Calls at Mean, Maximum and Minimum Temperatures During Summer of 2007

Categories of population	Mean temperature			Maximal temperature			Minimal temperature		
	r	*b*	*p-value*	*r*	*b*	*p-value*	*r*	*b*	*p-value*
Age 0-17	0.147	0.87	0.161	0.168	0.82	0.109	-	-	-
Age 18-39	0.454	3.07	0.000	0.431	2.41	0.000	0.435	3.57	0.000
Age 40-59	0.168	0.93	0.109	0.163	0.75	0.120	0.122	0.82	0.246
Age over 60	0.043	0.22	0.680	-	-	-	0.087	0.53	0.408

Note: *Shaded cells show statistically relevant data with 90-95% confidence level.*

During the 2009/2010 cold period, excess EMS calls (as opposed to the RP) were made for 7,352 children (0-17 years old) and 4,054 for people of the 40-59 age group. During the winter of the same year, additional EMS calls were registered in all age groups, with the highest number of excess calls for children, and the lowest number - for people over 60. The lower number of EMS calls during the cold period for people over 60 can be justified by the fact that such persons tend to stay at home as much as possible during the cold period, thus avoiding the action of many factors of the extremely cold periods, **Table 5-87**.

In the structure of deaths according to natural focal diseases, there were excess deaths during the warm period of 2007 as compared to the reference period. The analysis revealed the highest number of excess deaths for circulatory system diseases - 140 excess deaths as compared to the reference period, most of which were recorded during the summer months (139 cases). A lower number of excess deaths during the warm period were recorded for tumors (23 cases), endocrine diseases (13 cases), mental and behavioral disorders (9 cases), digestive diseases (9 cases), infectious and parasitic diseases (7 cases), nervous system diseases (6 cases), respiratory diseases (5 cases). Not all of these excess deaths can be dependent on high temperatures, as only some of the natural focal diseases show excess deaths in summer months as well. Thus, during the summer months there are excess deaths for parasitic and infectious diseases (10 cases), digestive diseases (10 cases), respiratory diseases (8 cases), the number of excess cases being higher as compared to the warm period, which shows a significantly higher number than for the reference period, **Table 5-90**.

Table 5-90: Cases of Deaths during Periods with Extreme Temperatures in Chisinau Municipality (by Natural Focal Diseases), abs

Periods/ Indicators		A00-B99		C00-D48		E00-E90		F00-F99		G00-G99	
		total	excess	total	excess	total	excess	total	excess	total	excess
Warm period	2007	85	7	598	23	42	13	17	9	26	6
	RP	78		575		29		8		20	
Summer	2007	44	10	302	3	16	3	7	3	13	3
	RP	34		299		13		4		10	
Cold period	2002/2003	82	3	408	-57	20	-8	7	-1	21	3
	2005/2006	90	11	447	-18	26	-2	4	-4	12	-6
	2009/2010	69	-10	489	24	23	-5	10	3	18	0
	RP	79		465		28		8		18	
Winter	2002/2003	51	2	247	-32	11	-9	6	1	10	-1
	2005/2006	55	6	278	-1	14	-6	2	-3	10	-1
	2009/2010	40	-9	302	23	16	-4	6	1	10	-1
	RP	49		279		20		5		11	
Periods/ Indicators		**I00-I99**		**J00-J99**		**K00-K99**		**N00-N99**		**D00-D89**	
		total	**excess**	**total**	**excess**	**total**	**total**	**excess**	**total**	**excess**	**total**
Warm period	2007	1,631	140	115	5	264	9	22	-8	1	-1
	RP	1,491		110		255		30		2	
Summer	2007	835	139	58	8	135	10	11	-3	1	0
	RP	696		50		125		14		1	
Cold period	2002/2003	1,515	-3	136	18	238	13	28	2	1	0
	2005/2006	1,433	-85	123	5	248	23	27	1	2	1
	2009/2010	1,593	75	96	-22	257	32	22	-4	1	0
	RP	1,518		118		225		26		1	
Winter	2002/2003	896	-11	87	15	135	2	20	6	1	0
	2005/2006	871	-36	80	8	147	14	19	5	2	1
	2009/2010	977	71	57	-15	159	26	9	-5	1	0
	RP	907		72		133		14		1	

Both during the warm period of 2007 and during the summer of the year, excess EMS calls were recorded for patients with nervous system diseases (412 cases and 402 cases, respectively) and circulatory system diseases (398 cases and 255 cases, respectively, **Table 5-90**. The regression analysis of the reasons for the EMS calls shows a statistically significant dependence of respiratory system diseases (0.316<r<0.278, p<0.001) on mean, maximum and minimum temperatures. There were no excess EMS calls in patients with tumors, while the statistical analysis shows a statistically significant dependence of the overall number of EMS calls only at maximum temperatures. A particular attention should be paid to the nervous system diseases that persist practically throughout the studied period with a significant number of excess EMS calls with a medium and above medium correlation degree (0.485<r<0.667, p<0.001) with mean, maximum and minimum temperatures.

The highest number of EMS calls for patients with nervous system diseases have also occurred in July, when the body cannot rest even at night (due to higher minimum temperatures), which causes a major stress to the body. The correlation of other natural focal diseases does not show statistically significant relationships with air temperature, **Table 5-92**.

The monthly analysis of EMS calls showed that patients with different natural focal diseases responded differently during the period, depending on air temperature values and on the frequency of heat waves. During the first months of the warm period excess EMS calls were made for patients with digestive system diseases and endocrine diseases. In June, there was a high number of EMS calls for infectious and parasitic diseases, obviously caused by the effects of high air temperatures. During the following months (July, August), the number of EMS calls for circulatory and tumor system diseases had increased, with the maximum number in July, when two heat waves lasting a total of 15 days were recorded, **Figure 5-88**.

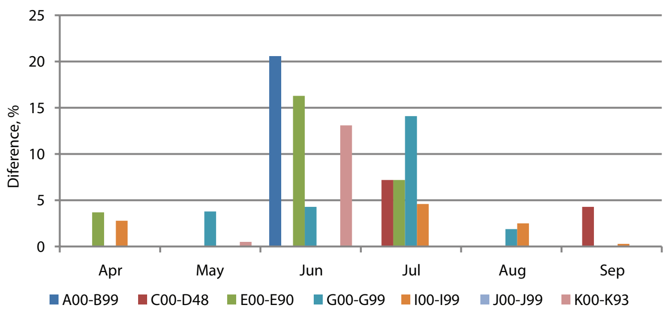


Figure 5-88: Evolution of Calls for Emergency Medical Services from the Perspective of Natural Focal Diseases.

The extremely low temperatures of 2009/2010 have had an essential impact on patients with circulatory system diseases

Table 5-91: Cases of EMS Calls during Periods with Extreme Temperatures in Chisinau Municipality (by Natural Focal Diseases), abs

Periods/ Indicators		A00-B99		C00-D48		E00-E90		F00-F99	
		total	excess	total	excess	total	excess	total	excess
Warm period	2007	3,814	-684	1,205	-218	669	0	5,915	-227
	RP	4,498		1,423		669		6,142	
Summer	2007	2,298	-229	664	-68	322	7	3,027	-174
	RP	2,527		732		315		3,201	
Cold period	2009/2010	2,290	-2,083	995	-98	527	11	4,943	-94
	RP	4,373		1,093		516		5,037	
Winter	2009/2010	1,402	-1,185	635	-18	306	-2	2,936	-167
	RP	2,587		653		308		3,103	
Periods/ Indicators		**G00-G99**		**I00-I99**		**J00-J99**		**K00-K99**	
		total	excess	total	excess	total	excess	total	excess
Warm period	2007	11,952	412	24,563	398	17,857	-6,110	13,128	-346
	RP	11,540		24,165		23,967		13,474	
Summer	2007	6,274	402	11,337	255	9,107	-3,158	6,852	-188
	RP	5,872		11,082		12,265		7,040	
Cold period	2009/2010	9,844	375	23,278	243	46,573	31,575	10,449	100
	RP	9,469		23,035		14,998		10,349	
Winter	2009/2010	5,841	125	13,967	-57	28,648	15,295	6,111	-53
	RP	5,716		14,024		13,353		6,164	

Table 5-92: Linear Regression Parameters of EMS Calls at Mean, Maximum and Minimum Temperatures During the Summer of 2007

Categories of population	Mean temperature			Maximal temperature			Minimal temperature		
	r	*b*	*p-value*	*r*	*b*	*p-value*	*r*	*b*	*p-value*
A00-B99	0.164	0.34	0.116	0.132	0.23	0.210	0.069	0.17	0.514
C00-D48	0.140	0.12	0.189	0.218	0.16	0.039	0.025	0.02	0.817
E00-E90	-0.083	-0.05	0.439	-0.021	-0.01	0.840	-0.147	-0.1	0.167
G00-G99	0.485	1.81	0.000	0.483	1.49	0.000	0.367	1.76	0.000
I00-I99	-0.127	-0.57	0.228	-0.167	-0.63	0.111	-0.145	-0.80	0.166
J00-J99	0.293	1.16	0.005	0.316	1.04	0.002	0.278	1.34	0.007
K00-K93	0.021	0.07	0.841	0.019	0.05	0.859	-	-	-
Total	**0.321**	**5.09**	**0.002**	**0.300**	**3.94**	**0.004**	**0.255**	**4.92**	**0.014**

Note: Shaded cells show statistically relevant data with 90-95% confidence level

as well (75 excess cases during the cold period, 71 of them during the winter months), **Table 5-89**. Throughout all the three cold periods - 2002/2003, 2005/2006 and 2009/2010, excess deaths were recorded for digestive diseases (with 13, 23 and 32 excess deaths during the cold period, and 2, 14 and 26 excess deaths during the winter months, respectively), with the highest number in 2009/2010. Excess deaths due to respiratory diseases were higher in 2002/2003 (18 cases during the cold season, 15 of them - during the winter months) and in the winter of 2005/2006 (8 cases). In 2009/2010 a number of 24 excess deaths were recorded during the cold period, including 23 cases during the winter months. During the cold period of 2005/2006 there were 11 excess deaths due to infectious and parasitic diseases, 6 of which were recorded during the winter months of the same year, **Table 5-89**.

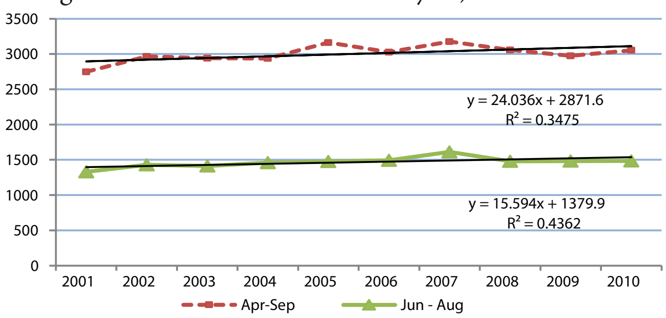


Figure 5-89. Dynamics of the Number of Deaths for All-Natural Focal Diseases.

The extremely low temperatures have a great impact on EMS calls of patients with respiratory diseases: during the 2009/2010 cold period a number of 31,575 additional calls were recorded, of which 15,295 excess calls were registered during the winter months. During the cold period, additional calls were recorded in patients with diseases of the nervous system (375 cases), circulatory system diseases (243 cases), digestive diseases (100 cases) and endocrine diseases (11 cases), **Table 5-91**.

The analysis in the multiannual dynamics (2001-2010) of the number of deaths during the hot period for all natural focal diseases shows a trend towards increase by 24 cases annually (R^2=0.34), while during summer there is a trend towards increase by 15 cases annually (R^2=0.43). Both during the warm period and during the summer months of 2007 there was an increased number of deaths, **Figure 5-89** The number of deaths due to circulatory system diseases recorded an increase in dynamics by 19 cases per year (R^2=0.40) during the warm period and by 12 cases during summer (R^2=0.43). The number of deaths due to circulatory diseases increased substantially during the summer of 2007, **Figure 5-90**.

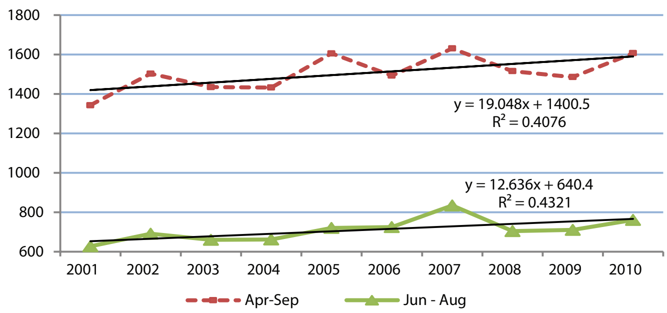


Figure 5-90: Dynamics of the Number of Deaths Resulting from Circulatory Diseases.

The deaths resulting from digestive system diseases during the warm period showed an increasing trend, by 5 cases annually (R^2=0.45), and by 2 cases in summer (R^2=0.25), **Figure 5-91** The increasing trend of deaths due to tumors during the warm period was by 10 cases per year and by 5 cases in summer, with a significant credibility of the approximation (R^2=0.65, R^2=0.52, respectively), **Figure 5-92**.

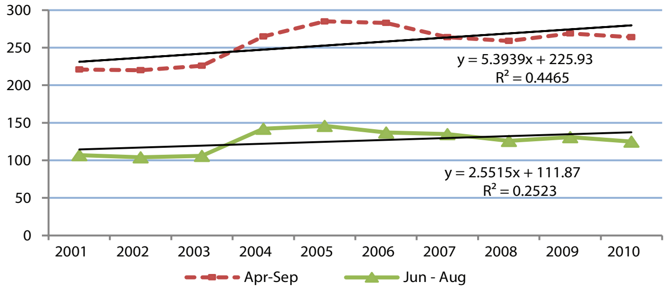


Figure 5-91: Dynamics of the Number of Deaths due to Digestive Diseases.

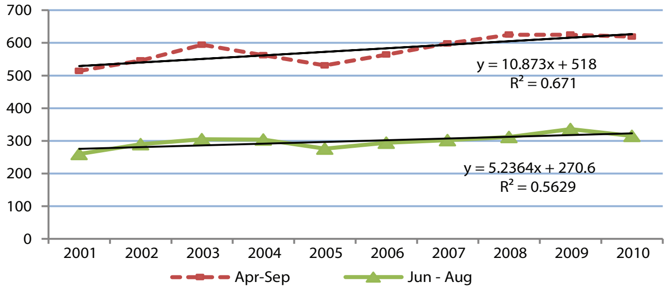


Figure 5-92: Dynamics of the Number of Deaths due to Tumors.

The multi-annual dynamics of deaths due to endocrine diseases, both during the warm period and during summer, is linear, with a slight increase; however, in 2007 an increase in the number of deaths was recorded, **Figure 5-93**.

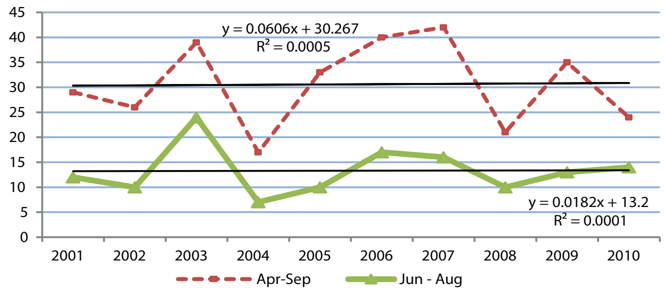


Figure 5-93: Dynamics of the Number of Deaths due to Endocrine Diseases.

Deaths as a result of mental and behavioral disturbances showed the negative dynamics during the studied period; in 2007, both during the warm period and during summer months a significant increase in the number of deaths was found, **Figure 5-94**.

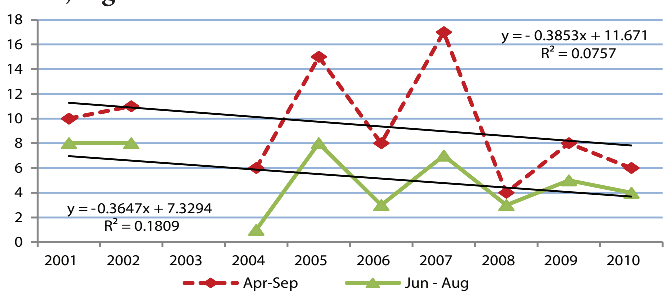


Figure 5-94: Dynamics of the Number of Deaths due to Mental and Behavioral Disorders.

Deaths due to infectious and parasitic diseases, in the multiannual dynamics, have registered a trend towards a slight annual growth (**Figure 5-95**). Deaths resulting from diseases of the nervous system and respiratory diseases during the warm period showed a negative dynamic, and an insignificant growth during summer. At the same time, both during the warm period and during summer months of 2007, an increase in the number of deaths resulting from nervous system diseases was registered (**Figures 5-96** and **5-97**). Deaths resulting from diseases of the genital and urinary system both during the warm period and during summer recorded a slight decrease in dynamics and were not influenced by the 2007 heat waves (**Figure 5-98**).

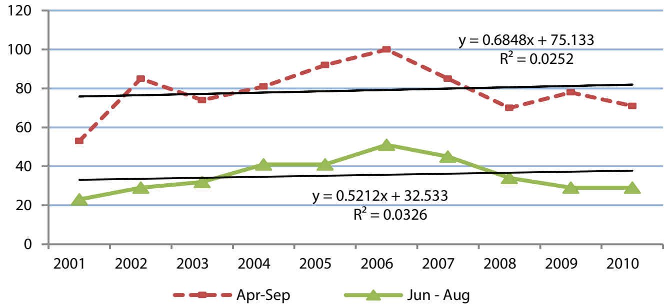


Figure 5-95: Dynamics of the Number of Deaths due to Infectious and Parasitary Diseases.

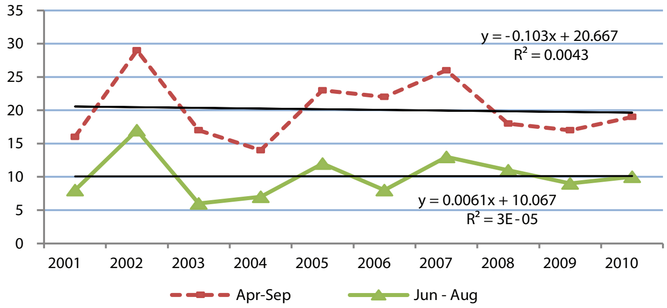


Figure 5-96: Dynamics of the Number of Deaths due to Nervous System Diseases.

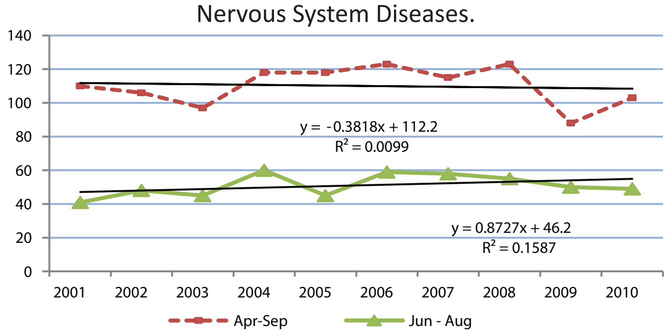


Figure 5-97: Dynamics of the Number of Deaths due to Respiratory Diseases.

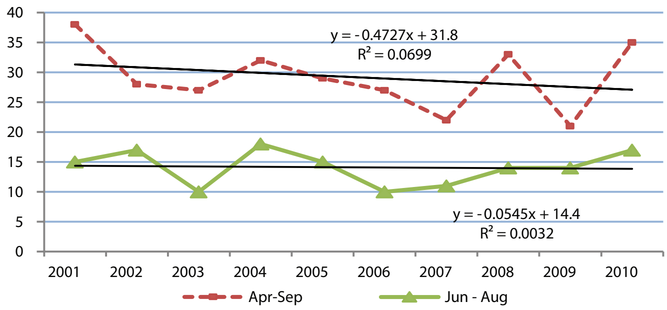


Figure 5-98: Dynamics of the Number of Deaths due to Genital and Urinary System Diseases.

During the cold period of the year, the number of deaths due to circulatory system diseases has shown a growth trend, but the degree of credibility of the approximation is very small (5 cases per year, R^2=0.04, 7 cases annually, R^2=0.15); the deaths due to tumors show a high credibility degree of the approximation (10 cases annually, R^2=0.75, 7 cases annually, R^2=0.87), while very little increase is recorded in deaths due to digestive diseases with a very low credibility degree of the approximation (1 annual case, R^2=0.07, 0.8 cases annually, R^2=0.04).

5.4.6.2. Projections of Future Changes in Health in the RM

5.4.6.2.1. Projections of Future Changes in Diarrhea Incidence

The Researchers Pantea V., Overcenco A. and Vlaicu B. (2009) conducted a study of the incidence of cases of diarrhea, recorded during the warm periods of years 1995-2008. The multiple regression coefficient shows an increase in the number of diarrhea cases recorded in total population in July and October (an increase of 42 and 50 cases of diarrhea, respectively), influenced by air temperature and a low negative rainfall factor. The number of cases of diarrhea in children increases in September and October (with 40 and 45 cases), which can be conditioned by collective food intake in educational institutions, **Table 5-93**.

Table 5-93: Multiple Regression Equations of the Incidence of Diarrhea with Mean Monthly Air Temperature and Precipitation for the Warm Periods of 1995-2008

Month	Total population	Children (age 0-17)
May	*Y= -454.691+21.2907*T+1.73507*P*	-
July	*Y = -968.699+41.9772*T-0.177723*P*	-
September	-	*Y = -671.609+40.4753*T+0.387353*P*
October	*Y= -544.714+50.0028*T-0.272518*P*	*Y = -483.023+45.3643*T-0.339232*P*

Source: Pantea V., Overcenco A., Vlaicu B., 2009: Weather effects on the diarrheal diseases incidence. Journal of Hygiene and Public Health, vol.59, nr.4/2009.

In order to assess the future changes in the incidence of diarrhea of the total population and children (age 0-17 years) in relation to mean monthly air temperatures and precipitation for the warm period of the year (May, July, September, October), were modeled projections of possible changes for three future time periods: 2016-2035, 2046-2065 and 2081-2100, according to the CMIP5 ensemble of 21 GCMs for three scenarios, RCP8.5, RCP4.5 and RCP2.6.

The analysis of the projections of future changes in the incidence of diarrhea cases in the Republic of Moldova in the short term (2016-2035) reveals an essential increase in cases of diarrhea in children during September, from 44 (RCP2.6) to 56 cases (RCP8.5). The largest number of cases of diarrhea in the total population is possible in July from 13 cases (RCP2.6) to 21 cases (RCP8.5), and 17 cases (RCP4.5), respectively. The lowest number of cases of diarrhea in the total population is projected in May, will be possible a low decrease in the incidence of diarrhea cases for the total population, from -1 case (RCP8.5) to -2.6 cases (RCP2.6), and/or an increase of +1.4 cases (RCP4.5), **Table 5-94.**

In the medium term (2046-2065), projections of future changes show an increase in the number of cases of diarrhea, especially in children, both in September, from 80 cases (RCP2.6) to 129 cases (RCP8.5) and/or 63 cases (RCP4.5), and in October, from 29 cases (RCP2.6) to 91 cases (RCP8.5) and/or 58 cases (RCP4.5), respectively. In the general population, in the medium term (2046-2065), a large number of cases are projected in July, from 24 cases (RCP2.6) to 102 cases (RCP8.5), and/or 57 cases (RCP4.5) and in October, from 24 cases (RCP2.6) to 92 cases (RCP8.5), and/or 55 cases (RCP4.5), respectively. The lowest number of cases of diarrhea in the total population is expected in May, from 8 cases (RCP2.6) to 28 cases (RCP8.5) and/or 11 cases (RCP4.5), **Table 5-94**.

According to the analysis of future projections of the incidence of diarrhea cases in the Republic of Moldova in the long term (2081-2100), the highest number of cases of diarrhea is expected in July in the total population (about 232 cases), but also an impressive number (186 cases) is expected in October according to RCP8.5 scenario. The lowest number of cases of diarrhea in the total population is projected in May, from 8 cases (RCP2.6) to 59 cases (RCP8.5) and/or 25 cases (RCP4 .5).

Over the same period, a larger number of diarrhea are anticipated in children in September (approximately 215 cases) and in October (176 cases), under RCP 8.5 scenario. The smallest number of cases of diarrhea is expected for RCP2.6 scenario, from 21 cases (in October) to 60 cases (in September), **Table 5-94**.

Table 5-94: Projections of Future Changes in Diarrhea Incidence in the RM, According to CMIP5 Ensemble of 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6

Time period	RCP	Total			Children (0-17 years old)	
		May	Jul	Oct	Sep	Oct
2016-2035	RCP8.5	-1	21.2	9.7	56.5	16.1
	RCP4.5	1.4	17.2	10.4	47.3	16.7
	RCP2.6	-2.6	12.6	11.2	44.6	17.5
2046-2065	RCP8.5	27.8	102.4	91.9	129.2	90.8
	RCP4.5	11.4	56.5	55.1	79.5	57. 5
	RCP2.6	7.7	24.2	24	62.9	29.11
2081-2100	RCP8.5	58.7	231.9	185.8	214.7	175.9
	RCP4.5	24.9	73.8	77	117.8	77.42
	RCP2.6	8	9.2	15.2	60.3	21.01

5.4.6.2.2. Projections of Future Changes in Cardiovascular, Respiratory, and Digestive Diseases

In order to assess the vulnerability to climate change of cardiovascular diseases (June-August), respiratory (November-March) and digestive (April to September), a regression empirical-statistical approach was used to correlate fluctuations of deaths due to cardiovascular, respiratory and digestive diseases, with climatic conditions in the most recent period (2001-2010).

The number of deaths due to circulatory diseases during the summer (June to August) shows a moderately strong correlation with air temperature in June ($r = 0.70$, $p < 0.05$). Coefficient R^2 shows that air temperature in June accounts 49% of the variability of deaths due to circulatory diseases in the years 2001-2010. The trend of deaths due to circulatory diseases in the summer (June to August), is statistically significant, and shows an annual average increase of 26 cases per year ($Y = 175.64 + 26.21 * T_{Jun}$), **Table 5-95**.

The deaths resulting from digestive diseases during the warm season show a moderately strong correlation with precipitation in May ($r = 0.74$, $p < 0.01$). The R^2 coefficient shows that precipitation in May accounts 55.3% of the variability of deaths due to digestive diseases in the years 2001-2010. The trend of deaths due to digestive diseases during the warm period of the year, is statistically significant, and shows an annual increase by 0.59 cases ($Y = 228.04 + 0.59 * P_{May}$), **Table 5-95**.

The deaths resulting from respiratory illness during the cold period of the year indicate a moderately strong reverse correlation with the January precipitation ($r = -0.70$, $p < 0.05$). The R^2 coefficient shows that the precipitation in January, during the years 2001-2010, accounts 49% of the variability of deaths due to respiratory diseases. The trend of the number of deaths from respiratory diseases in the cold period of the year, is statistically significant, and shows an annual decrease by 0.43 cases ($Y = 134.88 - 0.43 * P_{Jan}$), **Table 5-95**.

Table 5-95: The Linear Regression Equations for the Circulatory System Diseases, Respiratory Diseases, and Digestive Diseases with Mean Monthly Air Temperature and Precipitation for the 2001-2010 Time Period

Natural focal diseases	Period	Linear regression equations	*r*	R^2	*p-value*
Circulatory system diseases	June-August	$Y = 175.643 + 26.2148*T_{Jun}$	0.70	48.95	**0.0243**
Respiratory diseases	November-March	$Y = 134.878 - 0.4276*P_{Jan}$	-0.70	49.25	**0.0237**
Digestive diseases	April-September	$Y = 228.3039 + 0.5895*P_{May}$	0.74	55.27	**0.0137**

In order to assess the future changes in deaths due to circulatory (June to August), respiratory (November-March) and digestive (April to September) diseases, the projections of possible changes for three future periods: 2016 -2035, 2046-2065, and 2081-2100 were modeled according to the CMIP5 ensemble of 21 GCMs for three Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, relative to the reference period (1986-2005).

The analysis of short-term projections (2016-2035), for future changes in deaths caused by cardiovascular diseases (June-August), shows a slight increase of deaths in the summer months by 3.7% (RCP2.6) and/or about 4% (RCP8.5), respectively. A more pronounced increase in deaths due to circulatory diseases during the summer months is projected by 2081-2100 time period, from 5.5% (RCP2.6) to 18.5% (RCP8.5) and/or 10% (RCP4.5), respectively, compared to the reference period (1986-2005), **Table 5-96**.

The projections of future changes in deaths from respiratory diseases during the cold period of the year (November to March) indicate a steady decrease in the number of deaths due to respiratory diseases during the 21st century, up to 1% (RCP8.5) in long-term projections (2081-2100), compared to the reference period (1986-2005), **Table 5-96**.

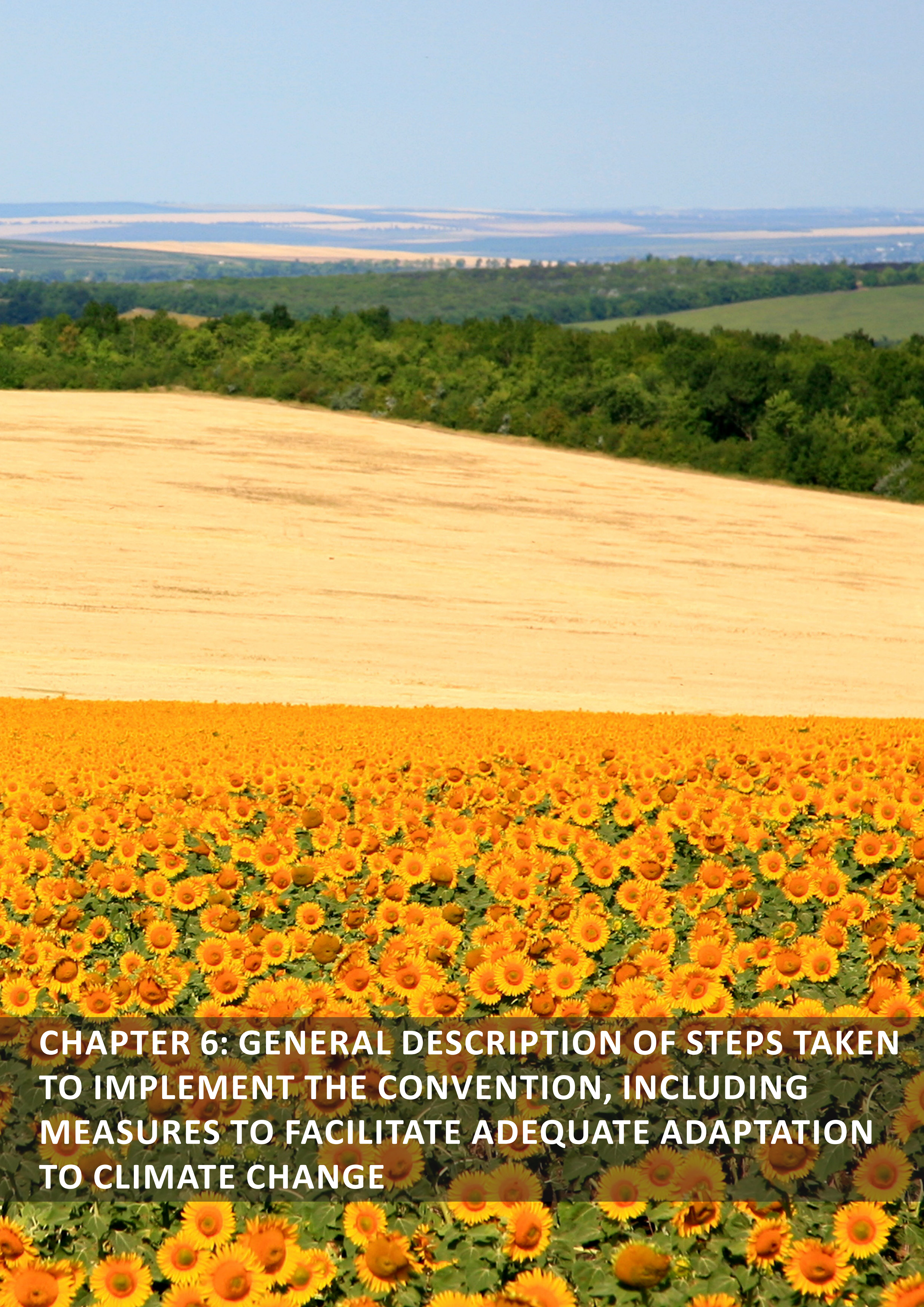
According to the CMIP5 ensemble of 21 GCMs for the three scenarios RCP8.5, RCP4.5 and RCP2.6, there are not expected significant changes in the number of deaths due to digestive diseases in the warm season of the year (April - September) during the 21st century, compared to the reference period (1986 - 2005), **Table 5-96**.

Table 5-96: The Projections of Future Changes in Cardiovascular Diseases (Jun-Aug), Respiratory Diseases (Nov-Mar) and Digestive Diseases (Apr-Sep), %, According to CMIP5 Ensemble of 21 GCMs for Representative Concentration Pathways RCP8.5, RCP4.5, and RCP2.6, Relative to the Reference Period 1986-2005

Time period	RCP	Cardiovascular diseases (Jun-Aug)	Respiratory diseases (Nov-Mar)	Digestive diseases (Apr-Sep)
2016-2035	RCP8.5	4.2	-0.7	0.0
	RCP4.5	3.8	-0.5	0.4
	RCP2.6	3.7	-0.5	0.6
2046-2065	RCP8.5	9.8	0.0	0.6
	RCP4.5	6.2	-0.8	0.4
	RCP2.6	5.3	-0.2	0.9
2081-2100	RCP8.5	18.5	-1.0	-0.1
	RCP4.5	10.0	0.6	0.5
	RCP2.6	5.5	-0.9	0.6

Note: In the reference period 1986-2005, the number of deaths due to circulatory diseases in the summer (June to August), accounted 694.7 cases; the number of deaths from respiratory diseases during the cold period of the year (November - March), was 120.7 cases; and the number of deaths caused by digestive diseases during the warm period of the year (April to September) was 257.5 cases.

CHAPTER 6: GENERAL DESCRIPTION OF STEPS TAKEN TO IMPLEMENT THE CONVENTION, INCLUDING MEASURES TO FACILITATE ADEQUATE ADAPTATION TO CLIMATE CHANGE



CHAPTER 6: GENERAL DESCRIPTION OF STEPS TAKEN TO IMPLEMENT THE CONVENTION, INCLUDING MEASURES TO FACILITATE ADEQUATE ADAPTATION TO CLIMATE CHANGE

6.1. Received support to implement climate change adaption in the Republic of Moldova[187]

In its NDC, the Republic of Moldova has stated the importance of reducing its vulnerability and increase the capacity to plan and implement adaptation action at national and sub-national levels. The priority adaptation sectors include agriculture, water, forestry, transport, health, energy and regional development, along with a number of cross-sectoral adaptation priority areas referring to capacity building, gender equity, climate research, technology transfer, other (Fig. 6-1). Country development priority areas of external assistance are largely determined by the National Development Strategy "Moldova 2020" and by the commitments assumed under the RM-EU Association Agreement.

The Government of the Republic of Moldova is facing the difficult task of making adaptation investment decisions that would maximize citizens' welfare under the constraints of limited budget and competing demands for resources. Domestic resources for adaptation-related actions are allocated through the national budget by the Ministry of Finances and refer to dedicated adaptation actions along with incorporated adaptation benefits into sectoral development activities. Several public funds: National Environmental Fund, Fund for Regional Development and to some extent Energy Efficiency Fund and Moldova Social Investment Fund have supported water management, energy efficiency and road infrastructure projects that have incorporated adaptation benefits.

The government works to leverage resources from the private sector as well to finance investments in a range of resilient-development projects. A number of initiatives have been launched to foster public private partnership in climate adaptation. International companies working in the Republic of Moldova are increasingly aware of the need to foster sustainability as part of their Corporate Social Responsibility work, and this development is promising for advancing water efficiency, climate-smart agriculture, facility resilience to extreme events, and partnerships with local communities.

While internal domestic sources supporting adaptation action come mostly from the public sector, the policy makers face a growing challenge in committing to large scale transformational adaptation perceived as an additional element to the sustainable development. Due to domestic budget constraints, the external support received by the Republic of Moldova to address climate change plays an important role in planning and implementing adaptation action at the national and sub-national levels. The support was accessed through different instruments including loans, concessions, technical assistance and grants.

The overall Official Development Assistance (ODA) portfolio addresses general climate change concerns, reflecting that adaptation is mainstreamed within ongoing development co-operation activities that are at risk to climate change, while some projects targeted dedicated adaptation planning and implementation. At the current stage of adaptation implementation in the country both dedicated adaptation and adaptation- relevant financing directions are important. The Government of the Republic of Moldova has elaborated the policy and development objectives that ensure better coordination and synergy in the process of programming, implementation, monitoring and evaluation of external assistance by establishing a broad consultative process and dialogue between the Government, the private sector and civil society. Received support is monitored through the External Assistance Management Platform (AMP) with the aim of increasing transparency in the use of external assistance, accountability in management and capitalization of financial

[187] In the text referring to the chapter 7 the names of the Ministries correspond to those of January 2014- July 2017 period. According to the Law nr136 of 7 July, 2017 on the Governmental reform, Parliament Decision no 189 of 21 July 2107 on the List of Ministries and on Government Decision no 594 of 26 July 2017 on restructuring specialized public administration, the names of the Ministries are changed as reflected on www.gov.md. In the chapter 7.4 the names of the Ministries are used according to the new, in force legislation.

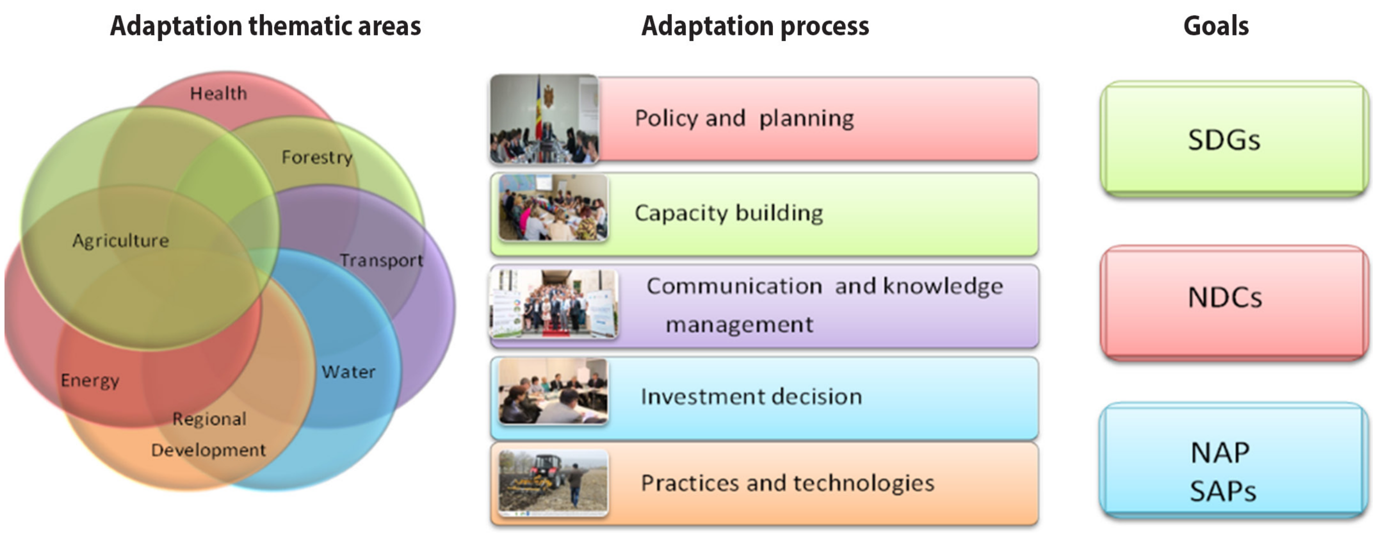
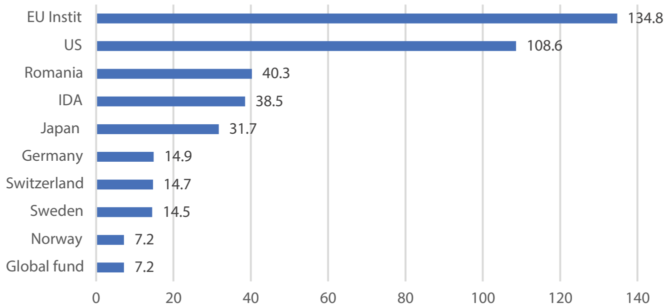


Figure 6-1: Adaptation Component, part of Republic of Moldova's NDCs aligned with NAP process, SDGs goals, country planning cycle.

resources that the Republic of Moldova benefits, as well as to secure one more good information of society as to how it is spent. Moldova uses also thematic Donor Coordinating Councils to harness adaptation support and align it with NDCs priorities. On the other hand, coordination of external support helps avoiding duplication of efforts considering the complexity of adaptation implementation.

The State Chancellery and line Ministries pay increased attention to strengthening of capacities for absorption of external assistance, as well as ensuring transparency and complementarity in the process.

According to OECD statistics[188], gross Official Development Assistance (ODA) for Republic of Moldova reached $ 370.7 million in 2015, with the two largest donors being institutions of the EU at $134.8 million, and the USA at $ 108.6 million (Fig. 6-2, Tab. 6-1).



Source: <http://www.oecd.org/dac/stats/aid-at-a-glance.htm>.

Figure 6-2: Gross ODA for Republic of Moldova (2014-2015 average), $ USD millions.

About 80% of climate-related development finance flow was committed through multilateral channels: the European Bank for Reconstruction and Development, the European Investment Bank, and the World Bank Group using mainly loans, while the remainder was committed by bilateral sources (e.g. the EU, Germany and Japan), mainly in the form of grants.

The AMP platform states that the ODA value in 2015 decreased by 26.7% compared to 2014, the main reason being the reduced financing from EU and World Bank budget support programs. At the same time, implementation of other forms of foreign assistance available to the Republic of Moldova in 2015 was continued. In getting foreign assistance, the Government has given preference to technical assistance and financial non-reimbursable funds. In 2016 technical assistance reached $ 116 million, and project support $ 7.05 million.

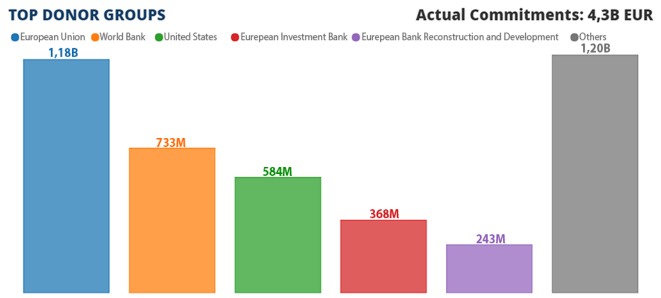
Table 6-1: ODA and Private Flows to Republic of Moldova (2013-2015)

Category	2013	2014	2015
Net ODA (USD millions)	348.7	517.9	312.6
Net ODA/GNI	3.9	5.9	4.5
Gross ODA (USD millions)	386.9	559.7	370.7
Bilateral share of gross ODA (%)	48.1	55.7	61
Net private flows (USD)	549.3	33.9	-24.0
Total net receipts	883.9	526.7	272.9

Source: <http://www.oecd.org/dac/stats/aid-at-a-glance.htm>

According to AMP platform, USA offered the largest support during 2015 as it was the last year of Compact agreement, totaling $ 236 million. Also through USAID envelope Moldova has received $ 30.62 million. Much of the support targeted crop production, food processing, post-harvest technologies that significantly contributed to strengthening agriculture sector resilience.

The AMP platform states that in 2016 the overall Official Development Assistance was 440 million Euro, growing by 33% comparing to 2015. Of this amount 227 million Euro were directed toward Government and civil society. The main donor is the European Union followed by the WB, Romania, EBRD, UN Agencies. EU is the leading supporting donor in 2017 too (Fig. 6-3) as the Republic of Moldova is a priority partner country within the Eastern Partnership and European Neighbourhood Policy and Instrument and the Black Sea Synergy, for both initiatives climate change is a priority issue.



Source: <http://amp.gov.md>.

Figure 6-3: The top donors of external support for Moldova in 2016-2017.

The collaboration between EU and Moldova was reinforced through the *Association Agreement* that covers a number of development areas, while Chapter 17 focusses on climate action in six areas: (i) mitigation, (ii) adaptation, (iii) carbon trading, (iv) research, development, deployment and other related aspects, (v) mainstreaming of climate considerations into sector policies, and (vi) awareness raising, education and training. EU Institutions are the top donors of ODA, the majority of bilateral aid is committed through grants. Government of Austria has supported Moldova in a number of climate-related initiatives, as establishment of the National Adaptation Planning process in the Republic of Moldova, sustainable water management, forestry sector reforms.

The cooperation between RM and UN is performed according to the Country Programme Document and the UN-Moldova Partnership Framework "Towards Unity in Action" for 2013-2017 under three major pillars: (a) inclusive growth; (b) effective governance; (c) climate change, environment and energy. The work of UNDP and the broader UN family aligns with the new National Development Strategy "Moldova 2020", and sector strategies. The third pillar of cooperation had a significant contribution toward advancing with climate change adaptation planning and implementation in the Republic of Moldova. The overall value of implemented by UN agencies projects during 2013-2017 is $ 180 million.

Strengthening institutional capacity to better access climate finances have been undertaken through a number of currently implemented projects, along with Green Climate Fund Readiness programme. Through *Support to Republic of Moldova in establishment and strengthening the NDA, development of strategic framework, and preparation of country programme*

[188] Financing Climate Action in Moldova .OECD Country Study, 2016, 28 p.

project the Republic of Moldova demonstrates commitment to build capacities and use them in enhancing country ownership and access to the GCF funds. Climate Change Office of the Ministry of Agriculture, Regional Development and Environment (MARDE) is the designated national entity (DNE) to implement Readiness Programme related projects.

A number of activities were implemented or are under implementation for raising awareness among sector ministries and informing them of the different sources of international finance available, in particular GCF and Adaptation Fund. One of the key aspects discussed with stakeholders was the importance of clearly articulating and communicating sectoral adaptation priorities in their potential adaptation projects. Stakeholders concerns were related to difficulties to access funds by the national entities and fragmentation of the received support. The emphasis on cross-sectoral capacity-building is reinforced by the sector-specific adaptation aid in forestry, health, water, energy efficiency. Agriculture and forestry projects target rural area population, while water, health, energy efficiency projects cover whole country population.

The received support helped the Republic of Moldova to engage in a number of adaptations sector-related activities, spanning from planning to on-site implementation of adaptation measures.

Agriculture received the largest share of adaptation-related aid and this is where adaptation is mostly implemented at the action level and reflects the importance of this sector in country's economy. At the same time it reiterates agriculture sector's high exposure to climate change, including climate risks. The largest DP-supported project for agriculture was *Transition to High Value Agriculture Project* (THVA), which was part of the $ 262 million grant assistance within Millennium Challenge Account Moldova (MCA Moldova) financed by the USA. The project encouraged the transition to high value agriculture by reconstructing irrigation schemes, reforming the irrigation sector, facilitating the access to finance in agriculture and growing high value sales. To achieve its objectives, the THVA project was structured into four major activities: rehabilitation of central irrigation systems, irrigation sector reform, access to agricultural finance, growing high value sales. In 2015 and 2016, the World Bank provided tranches of additional financing (totalling $ 22 million) to the *Agricultural Competitiveness Project* with Moldova which aims at complementary sector improvement through project objective that seeks to enhance the competitiveness of the agro-food sector by supporting the modernization of the food safety management system, facilitating market access for farmers, and mainstreaming agro-environmental and sustainable land management practices.

The International Fund for Agricultural Development (IFAD) *Inclusive Rural Economic and Climate Resilience Programme* during recent years has been the key effort with a total 2013-2019 budget of $ 46.3 million, including IFAD financing of $ 16.4 million and important contributions from the GEF ($ 4,370,000 grant component) and Denmark. The Rural Resilience Program continues in this direction, aiming at mobilizing some $ 38.7 million (including $ 23.7 million from IFAD) for program activities running through the year 2023.

Other multilateral development partners (Tab. 6-2) have contributed to advance in the climate adaptation in the agriculture sector. In 2014-2015 the Government of the Republic of Moldova also has reallocated 500 million MDL subsidies for such high climate sensitive area as agriculture promoting climate smart practices and technologies.

Table 6-2: Selected Development Partner Adaptation –Related Projects

Project title	Donor / Implementing Agency	Duration and Budget	Relevance to climate change adaptation
Supporting Moldova's National Climate Change Adaptation Plan-ning Process	Gov. of Austria	Duration: 2013-2017 Budget: 1,000,070 EUR	The project offer support to Moldova in putting in place its National Adaptation Plan (NAP) process building upon existing development planning strategies and processes and contributing to the implementation of priority adaptation actions; Develop the institutional and policy frameworks for medium to long-term gender-sensitive adaptation planning and budgeting; Strengthen the institutional and technical capacities for iterative development of comprehensive NAP; Demonstrate adaptation interventions in priority sectors to catalyse replication and up-scaling.
Climate Resilience through Conservation Agriculture *Inclusive Rural Economic and Climate Resilience Programme (IRECR)"*	GEF/ IFAD	2014-2020, 64.5 mln USD credit, 4,370,000 USD grant component (GEF)	The objective of the project is to enhance adaptive capacity/resilience of rural farmers through sustainable land approaches. Currently the project development grant has been approved and the project is under development.
"*Livada Moldovei"* project	EBI	2016-2020 120 mln USD credit	Installing irrigation and anti-hail systems in orchards, post-harvest technologies and development of nurseries for the production of propagating material.
Moldova: Soil Conservation	WB Prototype Carbon Fund / WB Prototype C Duration:	2002-2022. Budget: 19 mln USD	Moldova Soil Conservation project is reforesting 19,768 ha of bad lands in the process of heavy erosion and degraded unproductive pasturelands, by means of afforestation with tree and shrub species adapted to these adverse site conditions, providing urgently needed fuel wood and timber to rural people. The revenue from the sale of temporary Certified Emissions Reductions (tCERs) of the project is expected to partially supplement the Moldsilva's financial resources allocated to the project.

Project title	Donor / Implementing Agency	Duration and Budget	Relevance to climate change adaptation
Support for the elaboration of the National Program for Vegetable Genetic Resources for Agriculture and Food in Moldova	FAO	2015-2017 300,000 USD	Restoring the performance recording system that helps build a knowledge base such as basic animal performance, best production practices, best growth strategies.
Agriculture Competitiveness Project	GEF, WB	2012-2017 Budget: 4,435,500 USD	The Project Development Objective is to enhance the competitiveness of the country's agro-food sector by supporting the modernization of the food safety management system; facilitating market access for farmers; the Project is working on mainstreaming agro-environmental and sustainable land management practices and exchange on climate change adaptation measures in agriculture.
Conservative Agriculture - Developing a Sustainable Soil Management System in Moldova"	The Government of Japan	Budget: 4.8 mln USD	Promoting and implementing sustainable agriculture practices in Moldova.
Clima-East Pilot project in Moldova Sustainable management of pastures and community forests in Moldova's first National Park Orhei	EC / UNDP	Duration: 2013-2016 Budget: 694,805 USD	The project promotes ecosystem-based climate change mitigation and adaptation and aims to demonstrate a natural resource management model in the pastures and forests of Moldova. More specifically the project activities shall increase ecosystem's capacity to sequester carbon under pending climate risks, while at the same time retaining biodiversity and economic values.
Moldova Disaster and Climate Risk Management Project (DCRMP)	IDA Implementing Agent: WB	2010- 2014 Budget: IDA 10 mln USD (credit) GFDRR technical assistance grant 100,000 USD	The project development objective is to strengthen the State Hydrometeorological Service's ability to forecast severe weather, as well as to improve the capacity of the Government to manage emergencies and coordinate disaster response among local units by establishing the Emergency Command Centre. It will also initiate activities for adaptation in agriculture all these contributing to improved Moldova's capacity to prepare for and respond to natural disasters. The project seeks to strengthen capacities to: 1. monitor weather and issue early warnings of weather-related hazards by providing timely and accurate hydro meteorological forecasts and services; 2. manage and coordinate responses to natural and man-made disasters; and 3. help individuals, particularly farmers, be aware of, and adapt to natural hazards and climate variability.
Improvement in the management of pastures to reduce the impact of droughts on the livestock sector	FAO	2012 - 2015 Budget: 432,000 USD	The objective of the project is to increase the resilience and preparedness of small-scale farmers to natural hazards (mainly droughts and floods), to improve their capacity to mitigate these hazards, and to improve the response of MAFI. Outputs focus on substantive technical advice on DRR specific good practices in agriculture and livestock production to be made accessible to small-scale farmers, and also on reinforced capacity of MAFI. Reduce the impact of drought on the livestock sector by improving the management of pastures as the main impact of the project.
Transition to High Value Agriculture (Millennium Challenge Compact programme in Moldova)	Millennium Challenge Corporation (Millennium Challenge Account Moldova)	2010-2015 Budget: USD 262,000,000	The project aims at increasing incomes in the rural areas by encouraging high value agriculture and catalysing investments into high value production. It is also estimated that about 29 000 farmers or over 112 thousand people will benefit from. Challenge Compact programme in Moldova (Challenge Account Moldova) Budget: 262,000,000 USD individuals (farmers, owners of farmlands, agricultural enterprises and their shareholders, employees of agricultural enterprises operating in the areas covered by the rehabilitated centralized irrigation systems, the producers who grow or intend to grow high value products). Models for climate change adaptation measures and technologies in agriculture.
Climate Change and Security in the Dniester River Basin	EC and ADA (UNECE, OSCE)	2013-2015 Budget: 500 000 EUR	The project aims at increasing adaptive capacity of the riparian countries sharing the Dniester river basin, through improved transboundary cooperation. Main results will include the development of a basin-wide transboundary climate change adaptation strategy together with an implementation and resource mobilization plan and the support for the prioritization of measures and geographical areas for intervention through consultations, cost-benefit assessment and multi-criteria decision analysis as well as other decision support tools and implementation of a few priority measures in the Basin, such as construction of monitoring stations, restoration of ecosystems, flood risk mapping and communication.
Biogas Generation from Animal Manure Pilot Project	GEF Implementing Agent: WB	2011- 2014 Budget: 2,513,000 USD	The project's three-year development objective is to promote the transfer of a new environmentally sustainable renewable energy technology through piloting the use of animal manure for biogas-based heating and electricity production at the farm level. The development objective will be achieved by: 1. removing barriers to enable the use of biogas renewable energy technology in the country; 2. building farmer capacity in environmentally sound manure management systems to reduce environmental pollution; 3. reducing greenhouse gas (GHG) emissions to help address climate change effects by using a viable alternative to fossil fuels. The Global Environment Objective is to contribute to the reduction of GHG emissions through the adoption of on-grid renewable energy supplies.
Moldova Energy and Biomass project	European Commission and UNDP (UNDP Moldova)	2011-2014 Budget 14,560,000 EUR	The Project aims to contribute to a more secure, competitive and sustainable energy production in the Republic of Moldova through targeted support to renewable energy in form of biomass from agricultural wastes. The project will increase the use of renewable energy sources, specifically for heating public buildings and individual households in rural areas. It lays the basis for the establishment of functional markets for biomass technologies which will ensure sustainability of the project intervention beyond its lifetime

Project title	Donor / Implementing Agency	Duration and Budget	Relevance to climate change adaptation
Small Grants Programme of the Global Environment Facility (GEFSGP)	Donor: GEF Implementing Agent: UNDP Duration:	2012- 2017 Budget: 1,650,000 USD	The main objective of the Small Grants Programme is to generate national and global environmental benefits and socio-economic development opportunities through community-based initiatives and actions implemented by NGOs and Community Based Organizations in the areas of biodiversity conservation, climate change mitigation, sustainable land management, protection of i ion of international waters, phase-out of POPs and chemicals management.
Energy Conservation & Emissions Reduction Project	Community Development Carbon Fund/ WB	2006-2016 10 million USD	The overall project goal is improving efficiency of heating in the selected priority public buildings and to ensure energy consumption and respectively greenhouse gases emissions reduction, and thus providing global environmental benefits through the WB Energy-II project, which is under implementation in the Republic of Moldova. This Moldovan project aims at GHG emission reduction as a result of efficiency improvements and fuel switching measures for a series of public buildings (kindergartens, schools, vocational schools, hospitals, policlinics etc.) implemented via the WB Moldova Energy II Project.
EU-UNDP Low Emission Capacity Building Programme	EU, Australian Agency for Intl. Dev., Gov. of Germany (UNDP)	Duration: 2014-2016 Budget: 632,100 USD	The results of this project, the Low Emission Capacity Building Programme, are expected to be: (1) establish a robust GHG inventory system; (2) formulate the Nationally Appropriate Mitigation Actions (NAMAs). The programme is designed to provide coordinated, expert, capacity -building support to assist Moldova in formulation of the Low Emission Capacity Building Project proposal
Improvement in the management of pastures to reduce the impact of droughts on the livestock sector	FAO	2012-2015 Budget: 432,000 USD	The overall expected impact is to increase the resilience and preparedness of small-scale farmers to natural hazards (mainly droughts and floods), to improve their capacity to mitigate these hazards, and to improve the response of MAFI. Outputs will focus on substantive technical advice on DRR specific good practices in agriculture and livestock production to be made accessible to small-scale farmers, and also on reinforced capacity of MAFI. It is estimated that with proper management and cultivation the productivity of pastures could be increased by up to 50-100 percent, covering most of the needs of Moldovan farmers for forage during the grazing season and providing a significant supply of forage for winterization. Reduce the impact of drought on the livestock sector by improving the management of pastures as the main impact of the project. Introduce or spread good practices on pasture management and livestock production in areas affected by drought.
Sustainable tourism development in the Orhei National Park area	Donor: National Fund for Regional Development (Agency for Regional Development)	2013-2014 1,010,603 USD	The main objective of the project is to increase the investment attractiveness and visibility of tourism values in National Park Orhei. Specific objectives: creation, improvement and diversification of tourism infrastructure and services in National Park Orhei, building, administrative capacity of the park, training and human resources for inter-community cooperation activities by promoting diversification of the regional economy and tourism. Developing touristic infrastructure (visitor centres, camping's, craft markets) at a distance of up to one hour from the capital Chisinau.
Regional projects			
Prevention, Preparedness and Response to Natural and ManMade Disasters (PPRD-East)	EC Armenia, Azerbaijan, Belarus, Georgia, Moldova, Ukraine	December 2010 – June 2014 Budget: 6,000,000 USD	The overall objective of the project is to contribute to the peace, stability, security and prosperity of the Eastern Partner Countries and to protect the environment, the population, the cultural heritage, the resources and the infrastructures of the region by strengthening the countries' resilience, preparedness and response to man-made and natural disasters. The project aims at strengthening disaster management capacities through review of civil protection capabilities and legislative framework looking into enhancing cooperation with the EU.
Clima East Policy Project – Support to Climate Change Mitigation and adaptation in the Eastern Neighbourhood countries and Russia	Donor: EU Implementing Agent: Consortium led by HTSPE Ltd	Duration: 2012-2016 Budget: 8.2 million €	The Clima East Policy Project, funded by the European Union, is intended to provide support to the ENP East countries (i.e. Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine) and the Russian Federation (the Partner Countries/PCs) so that they are more equipped for greenhouse-gas emission reductions and better prepared to deal with climate change impacts. It also aims to facilitate dialogue in this area among the EU and the seven PCs. The Policy Project and the Pilots Project were implemented in close coordination with each other, ensuring that synergies between policy development and planning activity and the experience gained through the Pilots Project are recognized and utilized.
FLEG II – Forest Law Enforcement Governance	Donor: EU Implementing Agent: World Bank, EU, IUCN, WWF, Austrian Development Corporation	Duration: 2012-2016 Budget: EUR 9 million	The program supports governments, civil society, and the private sector in participating countries in the development of sound and sustainable forest management practices, including reducing the incidence of illegal forestry activities. The project aims to contribute to sustainable forest governance, management and protection in the ENPI East countries, ensuring the contribution of the region's forests to climate change adaptation and mitigation, to ecosystems and biodiversity protection, and to sustainable livelihoods and income sources for local populations and national economies.

Project title	Donor / Implementing Agency	Duration and Budget	Relevance to climate change adaptation
FP7 IncoNet EaP project	Donor: EU Implementing entity: consortium consisting of 19 institutions from EU member countries, Associated countries and Eastern Partnership countries.	2014-2020	The purpose of the project is to use, under the EU Framework Program 7 (FP7), a science, technology and innovation (STI) international cooperation network for promoting biregional dialogue between EU member states (and countries associated to FP7) and the Eastern Partnership countries, in identification of priorities of action in climate change, energy and health as the 3 most important societal challenges. The project contributes to approximation of EP countries to EU and assists with providing scientific, technological and innovation best practices in EU member countries in climate change area. STI network facilitates approximation of EP countries' CC policy to those of EU member countries.
Climate Change and Security in Eastern Europe, Central Asia and Southern Caucasus	Donor: European Commission, under Instrument for Sustainability Austrian Development Agency Implementing Agent: ENVSEC	2013-2015	The main aim of the project is to enhance and promote regional stability through transboundary co-operation on adaptation to the adverse impacts of climate change. The project is planned to produce regional background papers and conduct national and regional consultations. Project´s final output / deliverable is a report on the Climate Change and Security in Eastern Europe, Southern Caucasus and Central Asia. The report will primarily focus on the latest trends of climate change, vulnerabilities, and analyses of existing adaptation measures, lessons learnt from existing climate change adaptation projects. National consultations will be organized in each country for preparation of this report.
Prevention, Preparedness and Response to Natural and Man-Made Disasters (PPRD-East)	EU Implementing Agent: Consortium led by EPTISA -	2011-2014 EUR 5,988,000 / EU ENPI East Region	The project aims at strengthening disaster management capacities through review of civil protection capabilities and legislative framework looking into enhancing cooperation with the EU Civil protection Mechanism. Project aims at contributing towards peace, stability, security and prosperity in the Eastern ENPI region and at protecting the environment, the population, cultural heritage, resources and infrastructures by strengthening the countries' resilience, preparedness and response to man-made and natural disasters. It will also bring the partner countries closer to the EU's Civil Protection Mechanism.

Forestry is another key priority sector of adaptation however, with less DPs attention comparing to agriculture. The World Bank's *Agricultural Competitiveness Project* has financed investments and improved pasture and land management practices, which include planting windbreaks, connecting forest belts, and other complimentary actions. The EU has supported demonstration projects as part of Clima East Project in National Park Orhei, with the afforestation of 150 acres of degraded land, and 500 hectares of rehabilitated pastures. The investment of 535,000 Euros by the EU over the period of 2013-2016 demonstrated that benefits go beyond just soil and water protection, but enhances the economic and social wellbeing of the local communities.

Forest Law Enforcement Governance Program (FLEG) funded by the EU focused on institutional reform in the forestry sector of the Republic of Moldova. The program supported East countries in the development of sound and sustainable forest management practices, including reducing the incidence of illegal forestry activities. The project aimed to contribute to sustainable forest governance, management and protection in the ENPI East countries, ensuring the contribution of the region's forests to climate change adaptation to ecosystems and biodiversity protection, and to sustainable livelihoods and income sources for local populations and national economies.

Water sector through its cross-sectoral thematic areas of improving water supply, wastewater sector, water resources management, has benefited of relative large technical assistance of the DPs. Projects outcomes positively impacted population health and livelihood. The European Investment Bank has provided 2 million Euro technical assistance carried out from 2012 through 2015, and included seven tasks leading to a suggested Master Plan for flood risk reduction, building on preliminary flood risk assessment, hydraulic modelling and preparation of flood hazard maps, assessment of flood risks, identification of objectives and strategies for flood risk management, identification of measures to reduce flood risk, development of the phased investment program, development of the short-term investment program.

Adaptation cross-cutting areas referring to planning, coordination, mainstreaming, gender equality, monitoring and evaluation, EWS, communication, other aspects have been extensively addressed through ADA/UNDP Project, Supporting Moldova's National Climate Change Adaptation Planning Process totalling 940,000 EUR. The Project created effective policy frameworks and institutional arrangements across multiple levels and fields, strengthened institutions at national, sector, district levels to enhance their capacity to plan for and implement adaptation, promoted stakeholders cooperative action on adaptation, project supported decision-making, including through improving climate information services and understanding of climate information at the national and sectoral levels, integration of gender perspectives. Project supported implementation of adaptation through pilot projects initiatives and development of upscaling strategies.

The analysis of adaptation-related projects presents the information referring to the implemented or under implementation adaptation–relevant projects with details on the budgets, the duration, donor, objectives. A small number of very large projects have been implemented during 2014-2017 focusing of agriculture sector resilience however, with small size of grant component. The share of the grant component is bigger in small and medium size projects with few projects directly targeting adaptation implementation or planning.

While the ODA received support was a significant one, adaptation planning and action in the Republic of Moldova is to be scaled up from the currently existing situation given the likely impact of climate change and identified needs. To help frame climate adaptation investment needs beyond the timeframe of the *National Climate Change Adaptation Strategy*, the World Bank conducted an additional economic analysis of mid-to-long term climate adaptation investment needs in several sectors. According to this assessment, adaptation investments totalling $ 4.22 billion are to be present to mitigate climate impacts, with around $1.85 billion considered as relatively a higher priority in the near-future.

Under the implementation climate budget tagging (CBT) procedure will enable Government of Moldova to make more informed investment decision and facilitate better integration of climate change into national and sub-national budgets by tracking and monitoring climate relevant resource allocations in the budget system. The implementation of CBT will allow for better targeted assistance at the national and sector levels.

6.2. Sector integration into adaptation process

The sectoral approach in climate change adaptation of the Republic of Moldova is a dominating one at the current stage of country's development, however, cross- sectoral and sub-national approaches are gaining more consideration. Some sectors already are taking steps to implement adaptation actions, while other need more support in adaptation planning and implementation. In order to identify needed support to close the gaps of adaptation deficit at sector level and plan further adaptation actions, a number of sector level assessments and evaluations have been undertaken, emphasising the underlying sectoral causes and factors of vulnerability and addressing adaptation and resilience challenges under the changing climate.

6.2.1. Assessment of sectors' capacities to plan and implement climate change adaptation

Institutional capacity is an important element of climate change adaptation however, the development of this capacity is a big challenge for the Republic of Moldova's institutions. For its further building and strengthening with regard to planning and implementation of adaptation measures was important to understand the existing level of capacities in line ministries, therefore, an Institutional Capacity Assessment (ICA) was carried out during 2014 year in seven priority sectors: *water resources, agriculture, energy, health, transportation, forestry, and regional development*. The assessment focused on overall organizational performance and functioning capabilities of the sectors, and identified the sectors' needs in relation to climate change adaptation capacity development.

The assessment had the objectives to (i) identify currently existing capacity of the country's institutions and their potential to drive the mainstreaming of climate change adaptation across a broad variety of stakeholders and levels; (ii) perform analysis of capacity gaps in the country's ability to respond to climate change threats; and (iii) formulation of recommendations on addressing these gaps, based on which a Capacity Development Plan (CDP) to be produced.

The assessment considered country's framework conditions with focus on political commitment to influence climate specific capacity, on the opportunity structure for climate actions: whether they limit and impede, facilitate, or even incentivize climate actions—through a range of inter-related capacity variables, such as ownership, institutional arrangements, competencies, relationships and resources, that will gauge stakeholder sensitivities and awareness at the national and regional government level in terms of a) institutional enabling capacity, b) institutional adaptive capacity (Fig. 6-4).

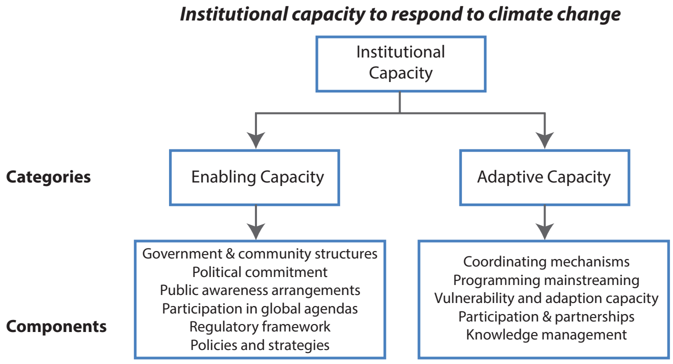


Figure 6-4: Institutional Capacity to Respond to Climate Change used in the Institutional Capacity Assessment of the Republic of Moldova.

Methodological Approach. Within performed assessment the systemic capacity was concerned with enabling environment, i.e. the overall policy, economic, regulatory and accountability frameworks: institutional capacity focused on overall organizational performance and functioning capabilities and ability of an organization to adapt to change[189]. At the individual level, the ICA referred to the process of changing attitudes and behaviours - imparting knowledge and skills while maximizing the benefits of participation, knowledge exchange and ownership.

Methodological approach in carrying out the ICA included:

- Desk review and analysis involving review of key documents, reports, existing literature and ongoing initiatives from the government, UN agencies, World Bank, European Union (EU), and national and international organizations. The review of government, political and institutional setting helped increase understanding and the need to improve the existing institutional setting to better integrate climate adaptation into government processes.
- A series of stakeholder consultations, focus group discussions and workshops, conducted by the CCO of the MARDE to discuss issues and challenges of climate adaptation in the Republic of Moldova. The consultations provided a set of key challenges and concerns that provided critical information in designing the ICA.
- A sector based, legislative and institutional framework analysis with a focus on determining the capacity of the formal enabling agencies—institutions that establish the policy and legal framework, set the rules and determine how resources are distributed.
- To establish an institutional capacity baseline, a self-assessment questionnaire was distributed to the 38 stakeholder agencies identified in the institutional mapping exercise to identify their baseline capacity and

[189] UNDP Capacity Assessment Methodology. User's Guide. 2008. 76 p

capacity needs. In total, 80 government officials and representatives of state agencies provided information during the data collection stage of the project. The self-assessment process, where staff members of the selected agencies rated their capacity levels both individually and organizationally provided an understanding of the prevailing capacity development status of the agencies

- Concurrently with the self-administered questionnaire, awareness raising consultation sessions were conducted to provide officials with an opportunity to increase their understating of climate related issues and to start articulating their needs.
- The gap analysis and recommendations. During the analysis process 'capacity gaps' across three capacity levels—an enabling environment/policy, organization and individual were identified along with needs for further planning and implementation of adaptation action.

6.2.1.1. Self-assessment questionnaire-based survey

National level. To assess the capacity to address climate adaptation in the various ministries and sectors, a self-assessment questionnaire-based scorecard was conducted in 2014. The survey was jointly conducted by the Climate Change Office, Ministry of Environment and the consultants of ADA/UNDP project *Supporting Moldova's National Climate Change Adaptation Planning Process*. The survey included 38 agencies of seven sectors (regional development, water, agriculture, energy, human health, transportation and forestry) and several other line ministries.

The scorecard focused on the strengths, challenges and priorities as perceived by the respondents, by asking them to define: i) their perception of the current level of capacity in their organization; ii) their desired level of capacity in their organization within the project timeframe; and iii) The priority given to each capacity. Respondents were asked to rank, on a 5-point rating scale, their estimate of their institutions' current functional capacity to engage in climate adaptation across 4 functional categories: (i) Understanding of the enabling environment (institutional, policy and legal framework) for climate change; (ii) Capacity for the planning, implementation and monitoring and evaluation for climate related projects; (iii) Capacity for climate change knowledge management; and (iv) Capacity for community engagement.

In terms of consideration of climate issues as a national or sectorial priority, when averaged across all responses, 48% of responses ranked climate of medium priority across all 52 aspects, with the balance of responses split almost evenly between high (27%) and low (24%) priorities (Fig. 6-5).

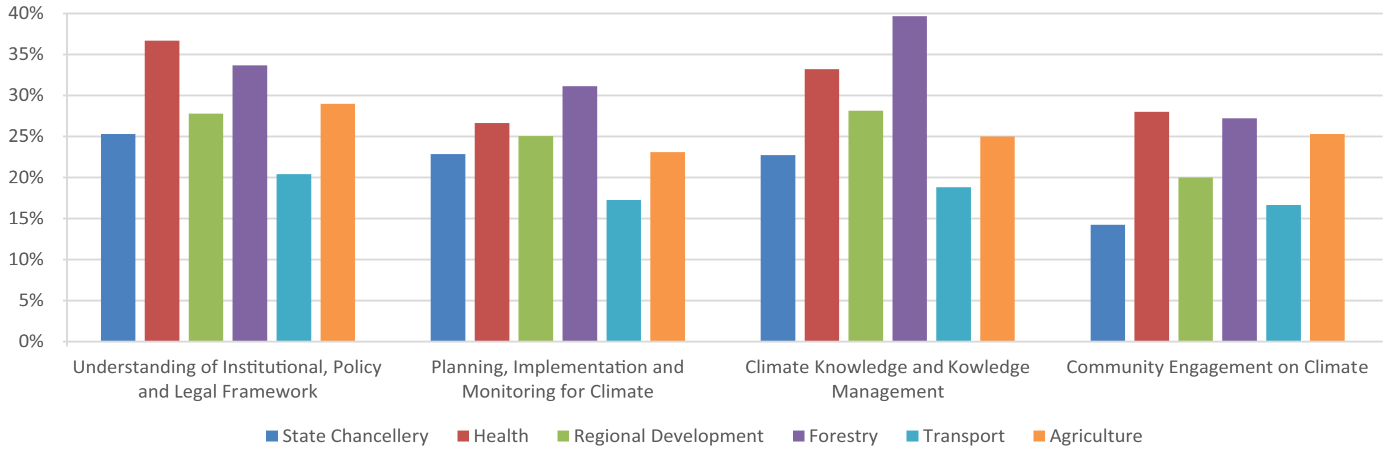


Figure 6-5: Prioritized baseline sectoral capacities developed on the results of self-assessment survey undertaken in 38 institutions of the Republic of Moldova.

On elements considered of core relevance to sector activities, responses tended to be consistent within each sector. National responses tended to vary both internally and when compared to their sectorial counterparts. The accretion of results in the middle range indicates that within each sector there tends to be general agreement on the various capacity aspects, as well as agreement on ability to absorb change in the context of current staffing and funding availability. On elements considered non-core to each sector, responses tended to present an overly optimistic estimate of current capacity levels and a widely optimistic assessment of future capacity. For example, 20% of responses rated current climate related community engagement levels as acceptable with another 48% as on-going.

Overall, the assessment tool revealed a consistency in the gaps between current and desired capacities across all dimensions. This indicates that, for the most part, the capacity issues are structural and reflect external constraints such as funding and staffing.

When combining aggregate gaps between current and desired capacities (Fig. 6-6) with the importance attached to them, the sectorial pattern is distinctly different.

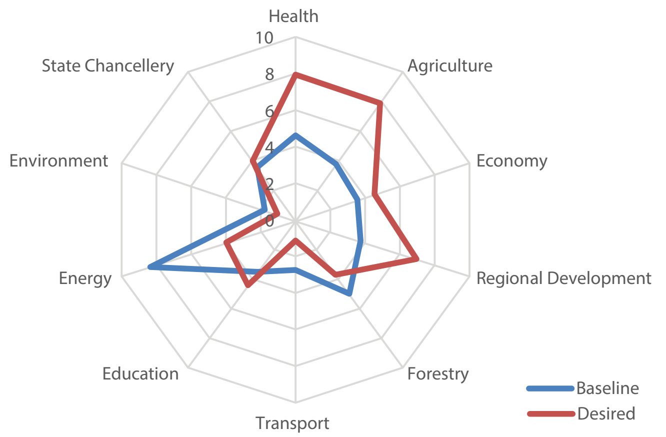


Figure 6-6: Differences between prioritized functional climate adaptation capacities of sectors and line ministries.

Ministries and sectors that depend on technical skills show a higher potential to increase their capacity, while ministries and sectors whose capacities also depend on physical assets show a much lower ability to increase capacities. This is probably due, in part, to the need for an infusion of capital in order to upgrade the capacities of physical assets. National line ministries also appear to reflect lower capacity levels for both current and desired capacity when compared to sectoral ones.

In analysing the prioritized functional capacities across six sectors (health, regional development, agriculture, energy, forestry and transportation) the assessment tool revealed a consistency in the gaps between current and desired capacities across all dimensions. The largest gaps appear in the dimensions related to: (1) the need to identify clear climate priorities in strategies and plans; (2) the need for clear functions and roles; (3) the need for monitoring of implementation activities with clear outcomes/outputs and indicators; (4) the need for effective leadership; (5) the need for an effective coordination mechanism; (6) the need to disseminate climate knowledge to regional and local levels; (7) the lack of good practice examples; (8) the integration of evidence-based decision making into programming; and the (9) the lack of effective community engagement. Overall the indicators reveal capacity gaps across a range of climate related dimensions.

When looking at the individual indicators weighted for importance, the top ten indicators are divided among dimensions relating to planning, monitoring and evaluation (5 indicators), creation of an enabling environment (4 indicators) and climate related knowledge management (1 indicator). These ten indicators constitute a list of potential priorities for CD responses for climate adaptation (Fig. 6-7).

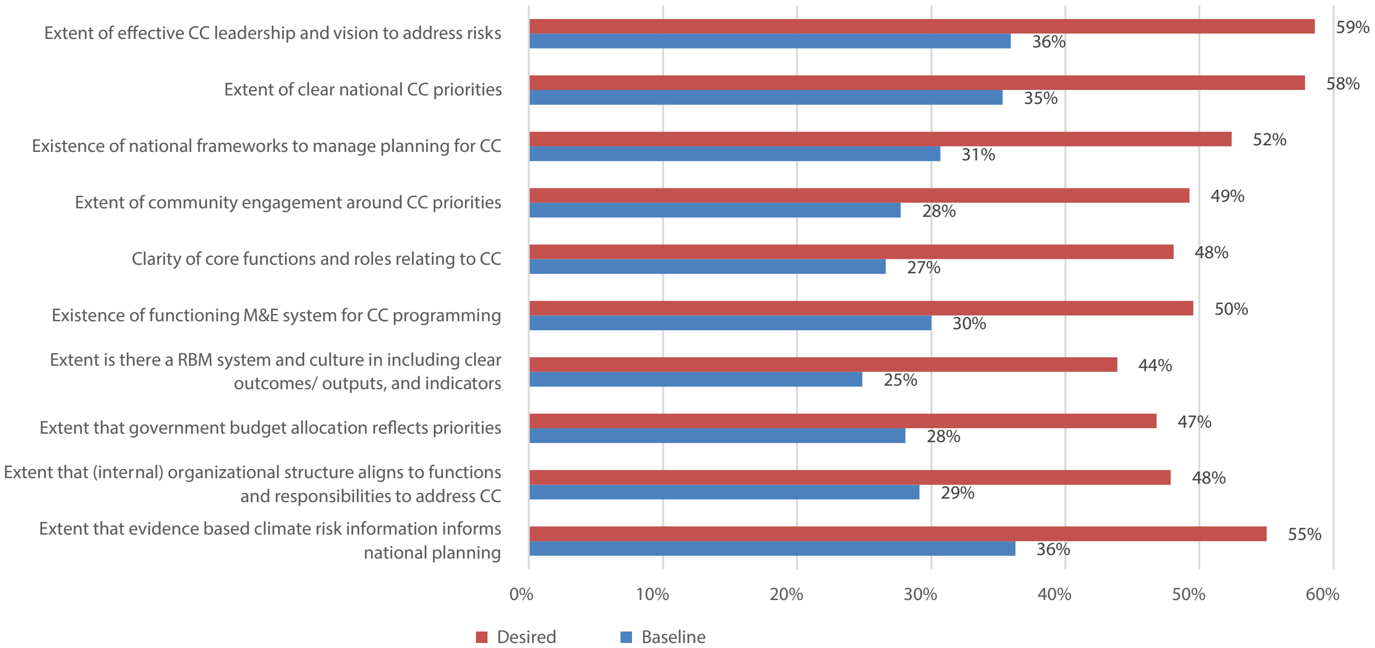


Figure 6-7: Top ten potential priorities for capacity development for climate adaptation identified in the institutional capacity assessment undertaken in 38 institutions of the Republic of Moldova.

In general, the widest gaps between current and desired capacities are mainly found within the first and second dimension of the scorecard (planning, implementation, M&E and enabling environment), which reflects the need to strengthen these components for further implementation of adaptation action.

Sub-national level. In the Republic of Moldova, the sub-national level includes agencies with countrywide policy, planning and function authority within a given sector and those with regional (provincial) level authority within a given sector. The capacity to implement and succeed in achieving long-term climate change mitigation and adaptation objectives is closely linked to the ability of regional authorities to meet these challenges. While the ICA did not focus on local authorities per se, it used the Ministry of Regional Development and Constructions (MRDCs) three Regional Development Agencies (North, Central, South) as an indicator of conditions and awareness at the local level. This approach is congruent with both the MRDCs legal mandate as aggregators of priorities and needs from the local level to the national one and as diffusers of national priorities to the local level.

Within this context there are clear differences between the three regions in their baseline capacity. The central region scored consistently higher in understanding of the current institutional and legal framework for climate change; in understanding of climate knowledge; in integrating climate change related planning and monitoring and in engaging with communities on the issue (Fig. 6-8)

In terms of capacity target levels, there was little variability on the surveyed aspects between the Central and Southern regions (Northern region personnel did not address this aspect) (Fig. 6-9). The assessed future capacity, based on current levels of funding and training, as well as the current legal framework averaged 10%. This consistency reflects both a good understanding by staff of their ability to internalize institutional change in the next 4 years, as well as recognition that much of that change depends on central authorities, additional funding, and technical support and increased staffing.

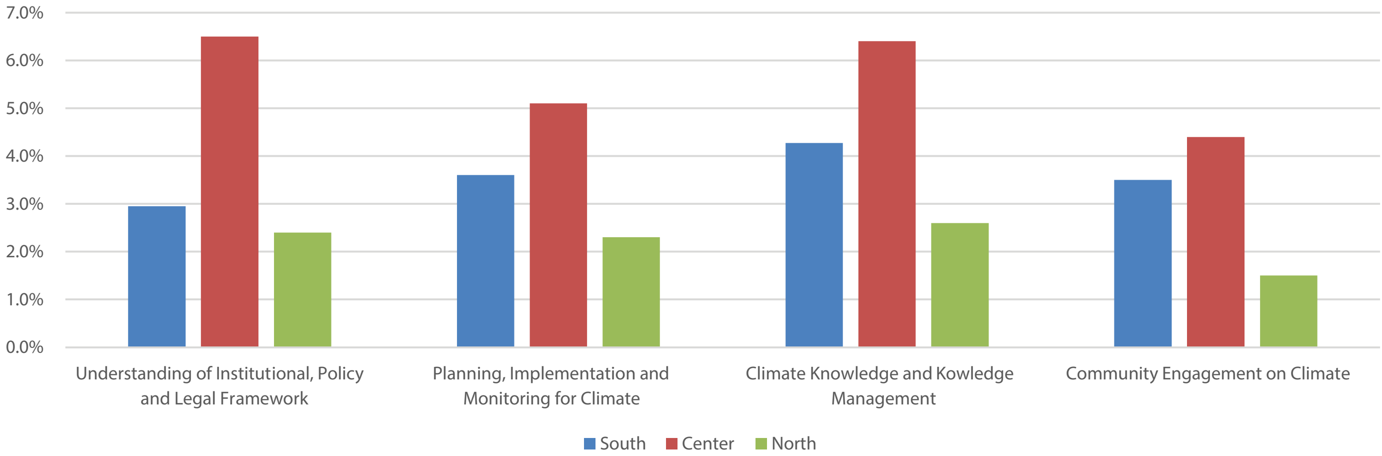


Figure 6-8: Baseline of three Regional Development Agencies - North, Central, South of the Ministry of Regional Development and Constructions built on self-assessment survey.

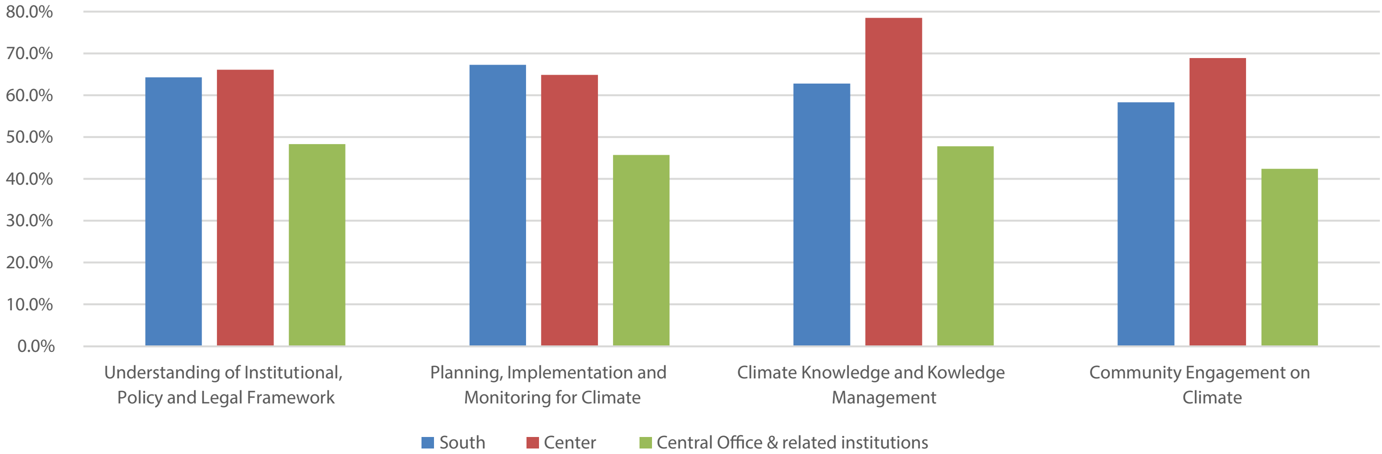


Figure 6-9: Comparison of prioritized aggregated functional desired capacity in the development regions and the central institutions.

All respondents to the survey at the sub-national level noted that climate change should require strong coordination between the national, regional and local level.

The main impediments to improved climate related capacity at the regional/sub-national level include:

- Limited knowledge availability of climate related impacts for both local development strategies and sector;
- Limited technical and staffing capacity;
- Lack of a policy, strategy or coordinating mechanism providing the basis and guidance for the coordination of regional and local climate related activities; and
- Limited capacity of lead agencies to coordinate and promote a higher degree of local level involvement combined with a limited understanding and awareness by local authorities on climate change impacts and adaptation approaches.

6.2.1.2. Review of adaptation related policies for priority sectors

Within ICA the analysis of policies and policy practices in relation to climate change adaptation at the national and sector levels was undertaken with the aim to identify the level of consideration to address climate related issues and provide recommendations for further mainstreaming of CCA into national and sectoral political framework. In the Republic of Moldova the national level provides the overall guiding policy framework within which lower levels (sectoral, regional and local) operate and it is at this level where overall political responsibility for climate adaptation is located. This level is vital for the reason that the national government sets legislation and regulations, many of which directly or indirectly affect the climate risks facing the country and creates the incentives and disincentives for exploring adaptation opportunities. At the national level priorities are defined and implemented through budget allocations and can therefore facilitate adaptation across different government levels. In addition, the delivery of important adaptation prerequisites, such as fundamental climatic and other data, analysis and assessments on climate change impacts, vulnerability and early warning systems are provided by the institutions and agencies with national level statute.

It was important to analyse the coordination of sectoral policies that takes place at the national level, as does the responsibility for many crosscutting issues and functions related to the coordination of sub-national authorities. Some of those are embedded in the inter-sectoral discussions that take place through regular planning and budgeting processes, but others have a separate operational role.

In conjunction with the content of national policies, the assessment also included the capacity of institutions to implement adaptation action.

I. Water Sector

The Ministry of Environment (MoEn) was the lead Ministry in charge of the water sector, responsible for developing the necessary national policy, legal and regulatory frameworks, and its subsequent implementation, including programming and implementation of the necessary investments in the water related infrastructure. The Ministry of Health (MoH) monitored water quality through its Public Health Bureaus. The MoEn also seek to access more information on water quality monitoring and to work more closely with the MoH to better inform the public on potential water quality problems. The Ministry of Regional Development and Construction (MRDC) had a significant contribution in the planning and development of water supply and sanitation infrastructure through its three Regional Development Agencies (RDAs). The Ministry of Environment also managed the National Environmental Fund (NEF), while the MRDC administered the National Regional Development Fund (NRDF). Together, these funds are the most important sources of national financing in the water supply and sanitation sector. The Ministry of Agriculture and Food Industry (MAFI) deal largely with water supply for agriculture needs, in particular for irrigation. Provision of environmental services such as municipal solid waste management, drinking water supply and wastewater collection and treatment remains the responsibility of the municipalities.

Various legal instruments have been enacted or drafted to address some of the major sectoral issues, such as the role of the public sector, institutional framework, use of and legal rights to water resources, protection and regulation of use, extraction and discharges into water resources, ownership and management of water supply and wastewater utilities, tariff setting, etc. However, their implementation has been slow, because of the political instability, constraints on financial and human resources and the slow path of decentralization. From a policy perspective, the policy is developed accordingly with separate goals, objectives and strategies laws, strategies and development policies linked directly or indirectly to water resources, none goes beyond 2025 in their timeframe and planning, however, these documents have a weak consideration of likely modifications due to climate change. There is a strong need to incorporate specific adaptation measures into the existing development strategies and plans in order to mitigate the impact of climate change in the longer-term as the sector represents the intersection of several key climate change adaptation issues (water resources, energy, agriculture, and human health) that will pose serious challenges to its capacity as well as the adequacy of water resources (Table 6-3).

Table 6-3: Water Sector Policy Gaps in Relation to Climate Adaptation

Policy	Policy Objectives	Gaps in Relation to Climate Adaptation
Water Supply and Sanitation Strategy in communities of Moldova, for the years 2007-2025	Environmental protection and environmental management, including water	Does not address or contain any condition or principles for climate change adaptation.
Regulation on flood protection levees (2012)	Establishes the requirements for the design, construction, reconstruction, repair and operation of dams, their operations and monitoring of status, as well as enforcement responsibilities	Though dams are considered essential flood protection for localities, climate adaptation issues are missing because responsibilities for their functions and duties are not articulated.
Program for the Development of Water Management and Hydro-amelioration in the Republic of Moldova for 2011-2020	The Program aims at increasing water use efficiency across sectors,	Refers to water use only in agriculture sector
Water supply and sanitation (WSS) Regional Sector Programme (RSP) 2014	Focuses on strengthening the WSS sector planning and programming process at regional and local level in order to optimize investments and develop sustainable projects in the specific sector. Establishes the directions of water supply and sanitation in the regional context, in the communities of 3 RDs.	Does not address climate change adaptation into a programmatic way, with specific measures to address climate risks at the regional level.
National Water Supply and Sanitation Strategy for 2014-2028	Aims at implementing water safety plan at high quality of water for human consumption. Strategy prioritizes interventions in the development of the sector and sets out medium and long-term reform objectives, which include inter alia: decentralization of the public WSS services to the LPAs of level 1; extension of central piped water supply and sewage systems and increase of rate of access for population. The strategy also promotes sustainable development measures and environmental protection of water resources by harmonizing the national legal framework with the EU Acquis.	The Strategy does include adaptation action, such as use of surface water management, but the action plan foresees the development of the group water mains from the Nistru and the Prut rivers, while for remote communities, the strategy refers to groundwater, which is known being of high heterogeneity.
National Program for the Implementation of the Protocol on Water and Health for2016-2020	Set the actions to reach national target indicators on human health and welfare, sustainable management of water resources, protection of aquatic ecosystems; preventing and reducing the spread of water-related disease	The program does not prioritise actions that would directly support the need of sector under the threat of changing climate

The main sector policy document is the National *Water Supply and Sanitation Strategy* covering the years 2014-2028, this policy document updates the *Water Supply and Sanitation Strategy in communities of Moldova (2007) for the years 2008-2025*, as well as essentially repeals the existing 2015 *National Water Supply and Sanitation Programme* that sets out development objectives for this sector. These documents are an important step in addressing water issues of Moldova. The *Framework regulation on using communal water supply and disposal systems* needs to be elaborated, including establishing rules for up-stream and down-stream users and for force majeure situations. The *Program for the Development of Water Management and Hydro-amelioration in the Republic of Moldova for the years 2011-2020* refers mostly to the water use in agriculture sector and aims at increasing water use efficiency.

The Ministry of Environment is the responsible organization involved in the National Policy Dialogue (NPD) on Integrated Water Resources Management (IWRM), which provides a platform for implementing policies focused on safe drinking water supply and adequate sanitation, prevention, surveillance and decrease of water borne disease through harmonization of water legislation of Moldova with EU directives. The MoU between MoEn and UN Economic Commission for Europe (UNECE) on the NPD for IWRM was signed in 2015.

At the systemic level, the main impediments to addressing climate change in and through the water sector include:

- lack of appropriate sectoral legislation;
- lack of clarity in jurisdiction and functions between agencies leading to limited implementation in areas where the mandates of different ministries and agencies overlap;
- need to streamline sectoral policies and agencies to reduce duplication of mandates and activities;
- lack of a clearly defined inter-agency coordination mechanism;
- lack of a coordinated system for monitoring the sector and for assessing/responding to risks;
- limited link between policy, functional programming and budgeting; and
- limited ability to identify internal capacity development needs.

The sector also faces systemic level gaps in its ability to provide water related services:

- limited ability to update and upgrade old and degraded infrastructure; and
- limited capacity to provide access to a clean drinking water supply to the rural population.

At the organizational level, the main impediments to addressing climate change in and through the water sector include:

- lack of prioritization of issues (and policy-based budgeting);
- limited oversight of programs;
- limited technical knowledge and the absence of a program to train officials on climate change and climate change adaptation issues.

II. Agriculture Sector

As in the Republic of Moldova nearly 90% of this production is rain-fed, there can be significant changes in the crop mix and area planted on a year-to-year basis, depending on the timing and quantity of rainfall and associated extreme events, like drought. In the case of a significant reduction in water resources due to climate change, the amount of irrigated land will probably be reduced and the condition of the land will be depleted. Water use in irrigation also has serious implications for competing uses, particularly in the future. Despite advances over the past several decades, agriculture remains a highly climate sensitive sector, and as such, much of Moldova's rural population and livelihoods are vulnerable to climate change.

The Ministry of Agriculture and Food Industry (MAFI) is responsible for the formulation and promotion of policies and strategies related to the development of the rural sector and food industry. MAFI also provides research, development, extension, education and training services through a range of subordinated organizations, including the Institute of Pedology, Agrochemistry and Soil Protection, the Animal Breeding and Veterinary Medicine Institute, the State Agrarian University and the Research Institute for Field Crops.

The main national sector strategy is the *National Strategy on Agriculture and Rural Development 2014-2020* aiming at increasing competitiveness of the agri-food sector, sustainable management of natural resources and improving livelihoods in rural areas. The strategic document comprises an objective referring to climate change adaptation however lacks distinct actions to reach it (Table 7-4). Within sectoral strategy the Ministry of Agriculture and Food Industry sets strategic view of converting existing agricultural practices of the Republic of Moldova into climate resilient agriculture with a focus on sustainable management of natural resources. The Strategy is complemented by the *Program for Conservation Agriculture, the National Plan for Implementation of the Program for Increase of Soil Fertility, National Monitoring Program of Pesticide Residues* and *Nitrate Content in Food of Plant Origin for 2015-2020*. The *Environmental Strategy for 2014-2023* also is supportive to actions aiming at improving soil quality and ecological reconstruction of degraded lands affected by landslides and farmland protection strips at 100% applying sustainable management.

Other important relevant strategies include: *Small and Medium Enterprises' Sector Development Strategy for 2012–2020*, Conservation *Agriculture Regional System* aiming at promoting the implementation of conservation agriculture principles.

Despite the advances achieved, a number of serious gaps still persist in policy- regulatory framework of agriculture sector, lack of coherence, synergy and complementarity among all relevant national strategies, and overlapping competences among different government institutions; deep-rooted structural inefficiencies in the existing systems of public support to agriculture; low inclusion of small- and medium-sized farms in existing subsidy scheme programmes (Table 6-4).

Systemic level impediments to addressing climate adaptation through the agriculture sector include:

- limited link between policy, functional programming and budgeting;
- limited coordination between ministries and subordinate organizations and limited coordination between industry and research institutions;
- lack of access to financial resources and distortions caused by underdeveloped capital markets which also inhibits private investments;
- inadequate resource base that is used inefficiently and leads to high resource costs;
- insufficient incentives to develop and use climate resilient and sustainable technologies for soil conservation combined with neglected agricultural externalities (pollution, degradation, etc.);
- lack of professional institutions to promote sustainable markets and the lack of research into the development and adoption of technology systems adapted to climate change; and
- insufficient trained personnel experienced in the use and management of new technologies.

Table 6-4: Agriculture Sector Policy Gaps in Relation to Climate Adaptation

Policy	Policy Objectives	Gaps in Relation to Climate Adaptation
National Strategy for Agricultural and Rural Development for the years 2014-2020	To address multi-functional character of agriculture. The objective is based on the achievement of synergies among economic, agricultural resource management and social areas: To ensure that the agri-food sector contributes to the sustainable achievement of the national economic and social development goals.	Climate change adaptation is considered under the specific objective 2.3. *Support to adaptation and mitigation of climate challenges effects on agricultural production.* The objective is an overall one lacking distinct actions to reach it. Other aspects of adaptation are mentioned under the specific objectives *Support sustainable agricultural land and water management practices; Support environmentally friendly production technologies, organic production and products ensuring biodiversity.* Agriculture industry is not recognized as a strategic one within the constraints of economic, social and global energy, focus on employability of rural population in agriculture to reduce poverty and lacking an action plan to protect the environment in the context of agricultural sector to reduce the impacts of climate change is missing.
National Strategy for Sustainable Development of the agro-industrial complex of the Republic of Moldova (2008-2015)	Ensuring sustainable le growth of agro-industrial sector, increasing the quality of life in rural areas by increasing the productivity and competitiveness of the sector.	The strategy focuses on technological modernization of the agricultural sector without adequate attention to systemic and environmental change or linkages to other sectors
Food safety strategy for 2011-2015	Orientation towards protection of human health and safety food	A comprehensive analysis of the link between product quality and climate change, especially the broad connection between food security and food safety in terms of global warming is missing.
Strategic Development Programme of the Ministry of Agriculture for the period 2012-2014.	Serves as the Ministry's short term (3 year) planning and management tool and as the instrument for communication of sectoral goals	The priority medium-term policy reorientation is missing and there is a need for a model farm for sustainable development and for the ability to track environmental impact and climate change
Program for Conservation and Increase of Soil Fertility 2011-2020	It is oriented toward improving soil fertility through stopping the active degradation of arable 887,000 ha by 2020 ha and implement measures for soil conservation and fertility improvement on 1.7 million ha	The proposed actions do not refer specifically to adaptation to climate change, whereas the link between improved soil fertility and sector resilience to climate change is missing.

The sector also faces systemic level gaps in its ability to provide services due to:

- lack of coherent economic policies (poor correlation between tax policy and tax regime);
- macro-economic conditions (high inflation and price fluctuations, instability of the national currency and exchange rate, balance of payments and economic growth, small market size) that affects subsidies, import duties and creates market distortions;
- poorly developed logistics and supply system; and
- limited ability to update and upgrade old and degraded infrastructure.

At the organizational level, the main impediments to addressing climate change in and through the agriculture sector include:

- lack of prioritization of issues (and policy-based budgeting);
- inefficient and outdated management structures;
- limited oversight of programs;
- poor information and knowledge dissemination about new technologies that leads to undeveloped infrastructure to support small projects and a perception that new technologies and systems are risky;
- lack of highly qualified personnel; and
- limited technical knowledge and the absence of a program to train officials on climate change and climate change adaptation issues.

III. Human Health Sector

Health care in Moldova is provided according to numerous distinct laws and resolutions, the most significant of which are the 1994 *Constitution of Republic of Moldova* (guaranteeing the free provision of minimum health care services) and the *Law on Health Protection* (1995). This law specifies the fundamental principles of health care in Moldova and ensures equal access to a comprehensive and qualitative health treatment. Sectoral priorities in the health system are guided by the *Health System Development Strategy 2008-2017 and* the *National Health Policy 2007-2021*. Their goal is to improve the health of the people of Moldova by continued improvement of health services and access to such services, and the reduction of risk and inequalities in the use and distribution of health services.

Additional strategies and policies that govern health related environmental and climate adaptation measures include the *Law on the Supervision of State Public Health* (2009) that provides operational guidance and measures in case of weather related public health emergencies; the *Law of Civil Protection and Emergencies* (2007) that address the operational participation of Civil Protection and Emergencies in hazard mitigation. These address climate change in a peripheral manner. The MoH is part of the platform for mobilization of combined knowledge, prioritization and advocacy on DRR at all levels as specified in the developed *National Disaster Risk Management Strategy* draft.

Current and previous studies also identified systemic challenges and gaps (Table 6-5) with the provision of drinking water to the rural population and the provision of services during heat periods in urban localities.

Though Republic of Moldova faces multiple and varied health threats from climate change impacts and increased risk from environmental conditions, health sector policies do not specifically mention climate change issues. In terms of the environment and climate change, the stated objectives are:

- develop sound and cost-effective interventions that ensure personal protection from communicable diseases and address their environmental determinants;

- develop a reliable surveillance system for preparedness and response to epidemics; and
- strengthen the capacity of the health sector to respond to the health consequences of emergencies and disasters.

At the systemic level, the assessment identified partial (and improving) harmonization with international standards and widespread public access to medical institutions as sectoral strengths. At the same time, systemic level impediments to addressing climate adaptation through the health sector include:

- lack of a national strategy to address climate related health impacts;
- need to streamlining sectoral policies and agencies to reduce duplication of mandates and activities;
- lack of a clearly defined cross-sectoral mechanism for coordination of adaptation related policies;
- limited ability to expand service network in the rural areas;
- limited and insufficient support to organizations and implementation support;
- limited climate related awareness and knowledge among professionals;
- limited staffing, equipment, and financing of the public health system;
- limited training for public health workers and service providers.

Table 6-5: Health Sector Policy Gaps in Relation to Climate Adaptation

Policy	Policy Objectives	Gaps in Relation to Climate Adaptation
Law on Health Protection (1995)	To ensure that all citizens have equal access to a comprehensive and qualitative health treatment.	The law does not include provisions relating to medical care under extreme weather conditions, nor does it provide for a particular plan of action to achieve desired results.
National Health Policy 2007-2021	To develop a legal framework to strengthen preventive health care and ensure high quality medical services.	Adaptation measures for preventive healthcare, primary hospital under extreme weather event was not a specific purpose of these policies.
Strategy for the Development of Health System 2007-2017	To provide for the continued improvement of health and access to health services. To reduce risk and inequalities in the use and distribution of health services.	The strategy does not include measures related to the prevention or mitigation of potential health effects arising from climate change.
National Strategy for Public Health 2014-2020	To set objectives of the surveillance and control of communicable and non-communicable diseases and principal activities of the state in pursuing these.	Does not refer specifically to CCA issues, does not set adaptation goals and targets
Strategic Development Plan of the National Health Information 2008-2017	To improve the stewardship of the health system by providing the necessary conditions to achieve the objectives underlined by the National Health Policy and the Health System Development Strategy	The strategy does not include climate change as a potential determinant of system needs.
National Program on Alimentation and Nutrition 2014-2020 of the Ministry of Health	To sets the actions to reduce the burden of preventable morbidity and disability and premature avoidable mortality due to non-communicable diseases related to diet, malnutrition and nutritional deficiencies.	There is no mention of the access of vulnerable and poor people in hazard situations, to safe, nutritious and sufficient food.
National Program for the Implementation of the Protocol on Water and Health 2016-2020	To set the actions to reach national target indicators on human health and welfare, sustainable management of water resources, protection of aquatic ecosystems; preventing and reducing the spread of water-related disease	The program does not prioritise actions that would directly support the needs of the sector under the threat of changing climate

Additional systemic level gaps include:

- capacity to assess and monitor vulnerability to climate change-related health risks;
- need to strengthen primary health care (including primary prevention) services to support capacity of local communities to become resilient to climate-related health risks;
- need to provide functional early warning systems related to the health consequences of climate change and climate variability;
- development (and ongoing assessment) of health and emergency management measures for reducing the impact of extreme events on health;
- economic analysis of health benefits when assessing investments in other sectors, such as agriculture and disaster risk reduction, in the design stage; and
- improved integration of health considerations into other critical national polices and strategies.

At the organizational level impediments to addressing climate adaptation through the health sector include:

- limited implementation mechanisms, monitoring, and inter-sectoral coordination.
- limited staffing, equipment, and financing;
- limited management capacity leading to ineffective operations;
- limited training for public health workers and service providers;
- limited ability to expand service network in the rural areas; and
- limited climate related awareness, technical skills and knowledge.

At the individual level impediments to addressing climate adaptation through the health sector include:

- limited support for adaptive approaches and technologies; and
- limited climate related awareness, technical skills and knowledge.

IV. Energy Sector

Climate change will have a range of effects across the energy sector; it already displays a series of vulnerabilities, in areas of production capacity, energy efficiency and security of supply, that stand to be magnified by climate change effects.

The overall responsibility of implementation of sectoral policies has the Ministry of Economy, two important institutions were created in 2010 – the Agency for Energy Efficiency, responsible for implementing policies on energy efficiency and renewable energy, and Fund for Energy Efficiency- a financial instrument in the field, created in 2012. The most comprehensive sector policy document is the *Energy Strategy of the Republic of Moldova until 2030* whose main goal is advancing development of energy and environmental conservation. It outlines the main objectives for ensuring the security of the energy supply, promoting energy conservation and efficiency, and making greater use of renewables to satisfy domestic energy demand. Additional energy policy documents are the *National Energy Efficiency Program 2011-2020* that proposes a 20% increase in renewable energy sources by 2020 and a 25% reduction in greenhouse gas emissions; the *Law on Energy Efficiency* (2010) that harmonizes Moldovan with EU standards; and the *Law on Renewable Energy Sources* (2007) complemented by a new law that supports development of the renewable energy sub-sector, *Law on Promoting the Use of Renewable Energy* adopted in 2016 seen as a new legal provisions in creating an enabling framework for renewable energy projects.

A key document was the Government Decision of 27.12.2013 approving *the National Action Plan on Renewable Energy*. This is a key document of the Republic of Moldova's energy policies to promote the use of energy from renewable sources in order to achieve the main strategic objectives of increasing energy security, long-term development in conditions of environmental protection and reduction of climate change. It defines mitigation sectoral targets to reach 20% of renewable energy by 2020, reflected in Moldova INDCs and sets out the legislative, regulatory and administrative actions needed to achieve these objectives. The document does not refer to adaptation targets and actions.

At all levels, the capacity gaps identified during the assessment included gaps in implementation mechanisms, monitoring, and coordination (Table 6-6). Lack of financing, qualified personnel, access to appropriate technologies and equipment and weak awareness levels were also reported.

Table 6-6: Energy Sector Policy Gaps in Relation to Climate Adaptation

Policy	Policy Objectives	Gaps in Relation to Climate Adaptation
Energy Strategy of Moldova until 2030	To ensure the security of the energy supply, promoting energy conservation and efficiency To make greater use of renewables to satisfy domestic energy demand	There are no estimates of losses from failure to adapt to climate change, and no analysis of barriers to implementation.
National Program for Energy Efficiency 2011-2020	Support capacity for a 20% increase in renewable energy sources by 2020. Support a 25% reduction in greenhouse gas emissions reductions.	There is no risk assessment of the direct and indirect costs associated with the failure to adapt to climate change.
Energy Act (2007)	Defines the relationship of the energy sector with other economic sectors.	The strategy does not include climate change as a potential determinant of system needs. There are no laws or incentives to support the industry's adaptation to climate change.
Electricity Act (2009)	Regulates the retail and wholesale electricity markets.	The strategy does not include climate change as a potential determinant of system needs. There are no laws or incentives to support the industry's adaptation to climate change.
Law on Promoting the Use of Renewable Energy (2016)	Promotes the use of renewable energies through large-scale renewable energy projects supported through a tender mechanism, which is expected to establish a fixed tariff and to allocate approximately 400 MW of capacity, while small-sized projects will have access to a FIT scheme managed by local energy regulator.	The strategy does not include climate change as a potential determinant of system needs. The Law does not refer to incentives to apply renewable energy as mean to adapt to climate change.
The National Action Plan on Renewable Energy (2013)	It defines mitigation sectoral targets to reach 20% of renewable energy by 2020, and sets out the legislative, regulatory and administrative actions needed to achieve these objectives.	The document does not refer to adaptation targets and actions.

At the systemic level, the main impediments to addressing climate adaptation through the energy sector include:

- limited integration of adaptation measures in the development plans of enterprises, national and sectoral plans;
- lack of climate adaptation target requirements in the legislative documents;
- limited financial and institutional capacity to improve governance and implementation capacity;
- limited staffing, equipment and financing for energy systems at the national level;
- limited capacity development and training for workers and service providers;
- limited ability to conduct economic analysis of costs and benefits of climate adaptation interventions to support increased adoption of new technologies and approaches; and
- lack of a clearly defined cross-sectoral mechanism for coordination and impact measurement of related policies and available financial resources.

At the organizational level, the main impediments to addressing climate adaptation through the energy sector include:

- limited ability to organize and create the necessary material reserves to maintain the operation of the enterprise during the climatic events;
- limited staff awareness and training for workers and service providers on the possible manifestations of climate change factors or sudden climatic events;
- limited ability to provide training and exchange of experiences with other energy organizations on best practices and techniques to reduce facility vulnerabilities;
- need to improve hydro-meteorological warning systems and develop a coordination mechanism with service providers to ensure to information flow in support of operational activities; and
- limited ability to conduct economic analysis of costs and benefits of climate adaptation interventions to support increased adoption of new technologies and approaches.

At the individual level, stakeholder consultations identified gaps in education and training for workers and service providers about the link between climate and energy and on the possible manifestations of climate change factors or sudden climatic events.

V. Transport Sector

Moldova's transport sector includes road, rail, air and river transport. The sector itself operates in a combination of state-owned and private companies, depending on the sub-sector. From a policy perspective, the sector is focused on: a) improving mobility conditions for citizens and freight; b) facilitating trade operations in domestic and international markets; and c) re-integrating the Republic of Moldova in the main international transport routes crossing Europe (Table 6-7).

Table 6-7: Transport Sector Policy Gaps in Relation to Climate Adaptation

Policy	Policy Objectives	Gaps in Relation to Climate Adaptation
Strategy of Transport and Logistics for 2010-2020	Defines the relationship of the transport sector with other economic sectors	The strategy does not include climate change as a potential determinant of system needs. There are no laws or incentives to support the industry's adaptation to climate change.
National Strategy for Road Safety (2013-2020)	To establish a basis for efficient and sustainable road safety and reduce the severity and consequences of road accidents To strengthen control of the road rules	The strategy does not contain objectives, actions, outcomes and monitoring indicators of climate change on transportation infrastructure.
Program for Strategic Development of MTID of Moldova for 2012-2014	Sets medium term political priorities: responsible and efficient management of the transport system, development and upgrading of passenger and freight transport according to EU standards, restoration and development of inland waterways of Moldova, liberalization and development of transport markets	The program does not prioritise policies that would directly support the need of sector under changing climate

The NDS supports the design, construction and operation of roads that implement environmental protection measures, including the procedures for assessing the environmental impact by promoting the construction and operating standards in terms of climate change.

The most comprehensive sector policy document is the *Strategy of transport and logistics for the years 2013-2022* with an overall objective to ensure efficient transport services to support the mobility needs of citizens. Its main principles in terms of environmental protection are ensuring that infrastructure projects comply with legal requirements on environmental protection and creating a legal and institutional environment in the transport and logistics sector to facilitate the country's sustainable economic development. Additional policy documents that provide objective, actions, outcomes and monitoring indicators that might be considered related to climate change include the *Private concept creation and development of the national network of international transport corridors* (2002) and the *Concept for development of shipping in the Republic of Moldova* (2008).

From the perspective of the institutional framework, there is a coherent mechanism for cooperation between the Ministry of Transport and Road Infrastructure and subordinated institutions. The main challenges lie in their operational and reporting functions. A major and on-going concern is the limited management capabilities (financial, technical and commercial) of the road maintenance system which is severely under capacitated due to a combination of centralized and inefficient planning and the high number of private road maintenance operators. To a lesser degree, this issue also affects the rail network.

At the systemic level, the main impediments to addressing climate adaptation through the transport sector include:

- the lack of a defined mandate for the Ministry and its related institutions, their powers and functions in the context of climate change;
- the financial resources of the Road Fund are not channelled into research climate related risk impact assessment, capacity or planning for the transport sector;
- the technical standards for the design, construction and operation of networks, especially the road network, are rigid and outdated and are not adjusted to the potential impacts of climate change; and
- limited integration of adaptation measures in the development plans of enterprises, national and sectoral plans.

At the organizational level, the main impediments to addressing climate adaptation through the transport sector include:

- limited ability to organize and create the necessary technical adaptation options to climatic events;
- limited investment in technical support for maintenance structures, transport networks, coordination and development of monitoring and reporting facilities in all sub-sectors;
- lack of floating units, new machinery and hydraulic structures that would allow entities to repair and rehabilitate structures;
- the technical rules and standards for safety are obsolete, and there is no transparent methodology for the identification and prioritization of infrastructure projects;
- The lack of a policy document (plan or program) to address the removal of obsolete and non-complying transport vehicles from the State Register and the monitoring of scrapping operations; and
- The lack of policy document addressing high pollution airspace overflight and their monitoring.

VI. Forestry Sector

The insufficient level of forest coverage (about 13% of the territory is covered by forests) has a serious impact on the country's environment and overall economic growth. Efforts are being undertaken by the Government to expand forests nationwide, in line with a national policy framework that aims at improving land and soil protection, reducing pollution, and supporting biodiversity.

The forestry sector already displays a series of vulnerabilities related to soil erosion, landslides, water resource degradation, drought intensification, and biodiversity deterioration that will be exacerbated by climate impacts. One of the main causes of forest degradation are illegal wood harvesting for energy (firewood) and construction, as a consequence of higher energy prices, the lack of effective control by the local administrations, low levels of ecological knowledge, traditional/cultural uses, excessive grazing and lack of adequate forest management.

More than 20 laws and government decisions that relate, directly or indirectly, to the management of forest areas govern the sector. The most comprehensive sector policy document is the *Forest Code (1996)* that governs all aspects of forest management and mandates activities related to protection of forestry areas (regarded as primary measures for sustainable forest management). According to the Forest Code, Moldsilva Agency has the authority to develop, approve, and assess forest management plans while the MOEN has oversight role on forest protection and use though it lacks staff to effectively fulfil its mandate (Table 6-8).

Table 6-8: Forestry Sector Policy Gaps in Relation to Climate Adaptation

Policy	Policy Objectives	Gaps in Relation to Climate Adaptation
Forest Code (1996)	Regulates sustainable forest management by rational use, restoration, protection of forests, maintenance, preservation and improvement of forest biological diversity provision of forest resources to current and future needs of society based on their multi-functionality.	The new version of the Forest Code will address climate change and its impacts.
Plan of action for implementation of the Strategy for Sustainable Development of the national forest (2004 –2020)	Includes specific actions to implement the strategy of sustainable development of the forestry sector in Moldova.	The plan provided for the developing ways to mitigate the negative influences on the forest from climate change in the years 2004-2020 the agency responsible for implementing "Moldsilva" but it has not been implemented due to legal challenges
Environmental Strategy for the years 2014-2023	Provides the integration of sustainable development and climate change adaptation in the forestry sector	Addresses climate change in an indirect manner only
The National Program for expansion of the areas covered with forest vegetation for the years 2014-2018	Technical-oriented document, conceived to slow down the soils degradation processes by extending the areas covered with forest vegetation. It also provides regionally-disaggregated indicators regarding the areas to be recovered.	Does not refer to a programmatic approach building and maintaining stable diversified forests adapted to climate change.

Additional policy documents include the *Law on State Protected Areas (1998), the Law on Afforestation of Degraded Lands (2000), the Decision on improvement of forestry management and protection of vegetation (1996), the Decision approving the regulations for harvesting authorization in the national forest fund and outside of it (2004)*, and other host of Moldsilva special orders and technical norms.

At the systemic level, the main impediments to addressing climate adaptation through the forestry sector include:

- overlapping powers between the agencies that coordinate the development of forestry related policies and their lack of collaboration;
- lack of a clearly defined cross-sectoral mechanism for coordination functional authorities;
- limited integration of adaptation measures in the development plans of enterprises, national and sectoral plans due to lack of regulatory framework that addresses climate change;
- lack of climate adaptation target requirements in the legislative documents;
- limited financial and institutional capacity to improve governance and implementation capacity;
- limited ability to conduct economic analysis of costs and benefits of climate adaptation interventions to support increased adoption of new approaches; and
- limited methodologies for climate impact measurement of related policies, plans and available financial resources.

At the organizational level, the main impediments to addressing climate adaptation through the forestry sector include:

- shortage of highly qualified scientists specializing in forestry and a large number of employees with poor forestry education;
- degradation of the training of highly qualified specialists forestry and forestry research field;
- limited ability to provide training and exchange of experiences with other forestry organizations on best practices and techniques to reduce forest vulnerabilities; and
- insufficient administrative capacity.

VII. Regional Development Sector

Republic of Moldova model of regional development is one that enables local governments to work with each other within the fundamental planning framework - the Region (3 Development Regions North, Central, South). The process mechanism allows local authorities to develop strategic investment and interventions in support for national priorities.

The Ministry of Regional Development and Construction (MRDC) is the main authority responsible for coordination and implementation of NDS "Moldova 2020" at the sub-national level and serves as both the aggregator of priorities and needs from the local level to the national one and as a diffuser of national and sectoral priorities to the local level. The Ministry also serves as the coordinating agency between the different sectors priorities. This unique aspect of the MRDC's activities places it at a critical juncture in terms of climate related information and adoption.

Regional development in the Republic of Moldova is based on a programming approach and the key strategic document at regional level is the seven-year *Regional Development Strategy* (RDS). The RDSs reflect the core programmes with established objectives, stated priorities then define the programming and operational details of the desired interventions. The RDSs are a regional articulation of the *Regional Development Strategy for* 2016-2020 (Table 6-9).

Table 6-9: Regional Development Sector Policy Gaps in Relation to Climate Adaptation

Policy	Policy Objectives	Gaps in Relation to Climate Adaptation
Law on Regional Development (2006)	To define the planning framework and funding procedures within which development planning occurs. To define the strategic planning responsibilities of regions. To increase local level involvement in strategic and regional planning processes.	Does not address or contain any condition or principles for climate change adaptation.
GD. 127 on measures to implement the 2006 Law on regional development (2008)	Defines the coordination responsibilities of national and central institutions for all planned actions. To identify national and regional priorities. To monitor the achievement of those activities.	Does not define NCCRD functions or provide climate adaptation related powers Does not provide the Regional Council for Development with power to address climate adaptation. The powers of the 3 Regional Development Agencies are distributed among a large number of people, which limits their ability to monitor climate change mainstreaming into sectoral policies.
Strategies for Regional Development Northern, Central and South	Defines the medium-term development strategies and priorities: • rehabilitation of physical infrastructure; • supporting private sector development; and • environmental protection and enhance tourism	Climate adaptation issues missing because they are not included in the national or sectoral policy documents.
GD. 933 on approving the Single Programming Document (2012)	Determines the short-term priorities for implementation of regional development policy through regional investment projects	Selection criteria for regional development projects do not include climate change adaptation in specific sectors and regional development priorities.
Operational Manual of the National Fund for Regional Development (2012)	Defines the selection criteria, accounting, reporting and evaluation procedures for use of the Fund.	The selection criteria partially reflect climate adaptation needs.
National Strategy of Regional Development for 2016-2020.	Aims to ensure the sustainable development of Moldova's regions, citizens' access to professional public services, boost up sustainable economic growth in the region and improve the normative and legislative framework on the sustainable development of Moldovan settlements.	The strategy contains the context for sustainable development of three regions of Moldova, that partially incorporate adaptation action however, the strategic document lacks explicit relevance to climate change adaptation.

The development process for the National Strategy of Regional Development (NSRD) is a participatory one and includes representatives from the sectoral ministries, the regional development councils, regional development agencies, academia and representatives from both the private sector and civil society. In developing the NSRD, all sectoral strategies are examined for concurrency with regional development priorities. NSRD objectives are closely linked to those of other sectoral policies.

Though the Republic of Moldova faces multiple and various threats from climate change and increased risk from environmental conditions, regional development sector policies do not specifically mention climate change issues, nor are these risks conveyed to the local level. The stated objectives of the current regional development policy are: (a) rehabilitation of physical infrastructure; (b) supporting private sector development; and (c) improving environmental conditions and enhancing tourism.

At the systemic level, the main impediments to addressing climate adaptation through the regional development sector include:

- lack of a clearly defined cross-sectoral mechanism for coordination and impact measurement of adaptation related policies, available financial resources and project implementation;
- need to complete regional development legislation and related legal reform that will ensure the Ministry's ability to establish priorities;
- limited ability to identify capacity development needs of regional development institutions and local authorities responsible for implementation;
- need to streamline sectoral policies and agencies to reduce duplication of mandates and activities; and
- focus on sectoral project selection at both the national and regional levels instead of opting for a strategic approach.

At the organizational level, the main impediments to addressing climate adaptation through the regional development sector include:

- limited ability to transition to a strategic approach that will drive both strategic criteria and project selection at both the national and regional levels in pursuit to achievement of stated climate related goals;
- limited ability to identify capacity development needs of regional development institutions and local authorities responsible for implementation; and
- limited climate related technical skills, knowledge in regional development institutions and local authorities.

VIII. Policy Review Summary

Overall, the following shortcomings in legislation and policy documents exist:

- in most of sectoral policies climate change adaptation (and climate change issues as a whole) is not mentioned explicitly. When mentioned, the discussion of limited to the environmental management and is not mainstreamed into broader economic growth and poverty alleviation language;
- sectoral legislation and policies do not address climate-related impacts or adaptation, even in climate-sensitive sectors such as agriculture;

- the absence of a specific reference to climate change in many laws hinders the development of sectoral programs for adaptation, because ministries and agencies without an express mandate to work on climate change adaptation cannot request funding for adaptation-related activities;
- the strategies fail to note or include climate adaptation considerations in proposed sectoral measures and targets, even when these targets are directly affected by climate variability and climate change.

Some of these shortcomings are also reflected in the results of the self-assessment survey that identified ten top priorities for CD for climate change adaptation: (1) the need to link leadership and vision to national climate priorities; (2) the need to identify clear climate related national priorities; (3) the need for national frameworks to address climate adaptation; (4) the need for clarity of roles and functions in relation to climate change; (5) the need for organizational realignment to reflect climate priorities; (6) the need for linking monitoring of implementation activities with budgeting processes, clear outcomes/outputs and indicators; (7) the need for an effective cross-sectoral coordination mechanism; (8) the need to diffuse available climate knowledge to institutions, regional and local governments; and the need to develop the good practice examples; (9) the integration of evidence-based decision making into programming; and (10) the need for effective stakeholder and community engagement. The summary of sectoral gap analysis is presented in the Table 6-10.

Table 6-10: Sectoral Gap Analysis Summary

Sector	Gap Analysis by Capacity Level		
	Systemic	Organizational	Individual
National	Climate change and climate adaptation are, for the most part, not mentioned in national sectoral strategies or sectoral development plans, and therefore, not funded or monitored	Regional branches of government agencies lack funding and training opportunities for staff	Understanding of climate change varies significantly across sectors and regions
Regional	Climate change and adaptation are not mentioned in regional and local development plans and therefore not funded or monitored	Regional branches of government agencies lack funding and training opportunities for staff	Adaptation is an unfamiliar term and concept in many sectoral agencies even when their work may be directly related. Lack of materials about climate change in Moldova

The overriding need for the development of capacity in climate change adaptation is reflected in the national policy framework that establishes climate mechanisms and defines responsibilities at various levels of Government. In this context, the adoption of the *Climate Change Adaptation Strategy of the Republic of Moldova was* a priority, the document was approved through the Government Decision No.1009 of 10.12.2014 for a period till 2020. It provides for an integrated vision on the development opportunities of the Republic of Moldova to react in a resilient manner to the impact of climate changes and it is underpinned by an in-depth study of future climate risks and impacts of climate change on vulnerable sectors. It is a standalone document that provides a comprehensive analysis of Moldova's vulnerability to climate change and its man directions to adapt. The general objective of the CCAS is oriented towards "*increasing the capacity of the Republic of Moldova to adapt and respond to actual or potential climate change effects*". The Strategy has as a prerequisite the development of a mechanism for adaptation to actual and potential climate change impacts, integrated and implemented across all sectors of the national economy so as to reduce vulnerability and increase resilience to the effects of these changes. The CCAS has three medium and long-term objectives under which adaptation actions are clustered for priority sectors, as well as cross-sectoral action.

Low Emission Development Strategy (LEDS) until 2020 (2016) serves as a strong foundation for lowering country emission growth, particularly in energy sector, strengthening the national greenhouse gas inventory system, formulating Nationally Appropriate Mitigation Actions (NAMAs) in the context of Low Emission Development Strategy and designing a measuring, reporting and verification (MRV) system to support implementation and evaluation of NAMAs and LEDS.

Another national level strategy in support to climate change adaptation is the *Strategy of Biological Diversity for 2015-2020*, which addresses the reasons that determine the loss of biodiversity by integrating the requirements to stop the process of losing biodiversity starting with the Government throughout the entire society, reduce direct pressure on biodiversity and promote sustainable use, improve the conditions of biodiversity by safeguarding ecosystems, species and genetic diversity, enhance benefits resulting from biodiversity and ecosystem services, building capacities for Strategy enforcement by participatory planning, knowledge management and building legislative and institutional capacities. The Strategy also aims to ensure measures to reduce the impact of invasive species by developing a study, a program and a guide on practices to combat invasive species.

National Environmental Strategy (2014-2023) ensures long-term environmental strategic planning congruency with EU norms. The strategy contains the context for development and approval of climate adaptation strategies, but lacks the institutional framework that would support the drafting of participatory strategies.

6.2.1.3. Political commitments to address climate change impacts

ICA used a set of indicators to gauge the extent to which national leaders and governments show political commitment to addressing climate change impacts. They include:

- political endorsement of global and regional climate change agendas and targets;
- explicitly addressing climate change in national development strategies;
- establishment and adequate resourcing of a clearly identified lead agency;
- directing the mainstreaming of climate change in sector policies and strategies; and
- directing the development, financing and implementation of national climate change programs.

Republic of Moldova has demonstrated a relatively strong and consistent political commitment at the global and regional levels of planning and strategizing (Table 6-11).

Various political leaders make public their concerns about climate change, its impact on the pillars of sustainable growth and continue to represent the country during important global forums. From a regional perspective, Moldova has made strong commitment to the ongoing development and implementation of tailored approaches to combating climate change. At the national level, efforts to address climate impacts remain to be on an *ad hoc* basis and without a cohesive countrywide coordinated approach. The recently developed *Low Emission Development Strategy* (LEDS) (2016) and the *Climate Change Adaptation Strategy* (CCAS) (2016) combined with *National Adaptation Planning process*, currently underway, are the first high-level national strategies that specifically address climate change.

Table 6-11: Extent of Political Commitment by Government to Address Climate Change Impacts

Endorsement of global and regional climate change agendas	Climate change in national development strategy	Establishment and resourcing of a national lead agency	National climate change programs initiated by government	Political approval to mainstream climate change into sector policies
Republic of Moldova is Party to the UNFCCC, Kyoto Protocol Republic of Moldova is a signatory to Paris Agreement Republic of Moldova's INDCs submitted to the UNFCCC	Climate change does not feature in the National Development Strategy Low Emission Development Strategy adopted, however, with little emphasis on adaptation action. In addition to mitigation, Moldova has submitted adaptation component as part of its INDCs	Climate Change Office within the Ministry of Environment Government reform under development	No national climate change program initiated by the government, except for projects funded through multilateral programmes	CCA mainstreaming approaches are introduced mainly through projects

On May 4, 2017 the Parliament of the Republic of Moldova ratified the *Paris Agreement*, according to which the Republic of Moldova will contribute to reducing the total national greenhouse gas emissions by at least 67 per cent by 2030 compared to the level of 1990. By ratifying the Paris Agreement Moldova engaged also in strengthening societies' ability to deal with the impacts of climate change, implementing adaptation action in all economic areas. Moldova's efforts to contribute to *Paris Agreement* goals are stated in its *Nationally Determined Contributions submitted* to UNFCCC in 2016 and adaptation component profile is a strong one. (I) NDC adaptation component strongly relies upon ongoing NAP process to inform development of adaptation goals and how they are implemented. Linking establishment of NAP process with NDCs will accelerate adaptation action and raise it at the level of mitigation component.

The main systemic level impediments to enhanced political commitment to addressing climate adaptation include:

- focus by politicians on immediate needs for economic growth;
- limited ability of the small pool of national experts and policy makers to use and simplify science and economics to influence political leaders;
- limited understanding by politicians of the extent of climate change impacts and the looming threat to economic growth and ecosystem services; and
- limited opportunities for the national climate change team to brief Cabinet and Members of Parliament on climate change impacts and the importance of taking urgent adaptation actions.

While there are shortcomings in the content of national policies, the most significant gap appears to be at the institutional level - implementation. The weak capacity of the public sector to deliver services and perform the functions is widely viewed with concern. Enhancing existing capacities include institutional rationalization and reform that has started in the Republic of Moldova in 2017.

The following shortcomings in legislation and policy documents exist:

- sectoral legislation and policies weakly address climate-related impacts or adaptation, even in climate-sensitive sectors such as agriculture;
- the lack of a specific reference to climate change in many laws hinders the development of sectoral programs for adaptation, because ministries and agencies without an express mandate to work on climate change adaptation cannot request funding for adaptation-related activities;
- the strategies fail to note or include climate adaptation considerations in proposed sectoral measures and targets, even when these targets are directly affected by climate variability and climate change.

6.2.1.4. Participation in global and regional agendas

One measure of institutional capacity at the national level is the ability of its political leaders and lead agency to engage in, influence and derive benefits from the range of global and regional agendas on climate change. The Republic of Moldova shoulders the obligation of ensuring its path to sustainable development under commitments to 18 international conventions and 4 international protocols through a relatively comprehensive environmental policy framework. The Republic of Moldova ratified the UNFCCC in 1995, the Kyoto Protocol in 2003 and submitted its Third National Communication on Climate Change in 2014 and recently (2017) has ratified the Paris Agreement. The Republic of Moldova also ratified the United Nations Convention to Combat Desertification (UNCCD) in 1998 and the Convention on Biological Diversity (CBD) in 1995 and has, so far, participated in all Conferences of the Parties. The Ministry of Environment (MoEn), the national environmental authority, is also the Republic of Moldova's Designated National Authority (DNA) on climate change and the Clean Development Mechanism. The Ministry also serves as the current UNFCCC National Focal Point. The Republic of Moldova also completed a National Capacity Self-Assessment (NCSA) on environmental management in 2005 and a Technology Needs and Development Priorities in 2013.

Representatives from the Government have been participating in many international climate change conferences and have engaged in climate change negotiations. Some have also benefited from training in Multilateral Environmental Agreement (MEA) negotiations and other related capacity building activities organized by development partners. There is, however, a disconnect between the country's involvement and engagement in international and regional *fora* and national level actions (Table 6-12).

Table 6-12: Climate Change Policy Gaps with Reference to the Implementation of the UNFCCC

National Level	Regional Agenda Level
The UNFCCC requires all signatory countries to communicate reports on their national circumstances and potential vulnerability to global climate change: • Moldova's First National Communication (2000) to the UNFCCC developed the scientific basis for climate change forecasts that became basis for mitigation recommendations. • Moldova's Second National Communication (2010) included a national GHG inventory, and addressed urgent and immediate domestic challenges related to climate change. • Moldova's Third National Communication (2014) updated its national GHG inventory, and refined its climate mitigation goals. The country made progress in developing and adopting comprehensive policy aiming at climate change mitigation and adaptation: • Moldova approved its Low Emissions Development Strategy until 2020 in 2016. • Moldova approved its Climate Change Adaptation Strategy until 2020 in 2014. • Moldova has started developing a National Adaptation Planning Process.	None of Moldova's bilateral and multilateral agreements on regional cooperation address the issue of climate adaptation: • The 2001 Concept of Environmental Policy focuses on integration of sustainable development policies with EU norms. • 13 bilateral agreements address cooperation with neighbouring countries and other regional partners on issues covered by the CBD and pollution monitoring. • Moldova and Denmark signed a MOU (2003) for collaboration on implementation of non-pollutant development mechanism of the Kyoto Protocol and the UNFCCC.

The Republic of Moldova is a signatory party to a series of agreements with the EU that provide support for enhancements of its national policies and a monitoring and reporting component that drive many of the recent changes to its legal and regulatory framework. In terms of their impact on climate adaptation, the most notable is the *Association Agreement* between the European Community and Moldova that promotes domestic, regional and international measures for climate adaptation; and the *Activity Program* of the European Integration: Freedom, Democracy, Welfare 2011 – 2014 [Governmental Decision 289 (2012)], that addresses climate change adaptation and sets the framework for congruency of Moldovan policies with European ones.

The main systemic level impediments to governments and national stakeholders making full use of and benefiting from participation and engaging in the global climate change agenda:

> *limited awareness by those outside of the "climate change community" of trends and opportunities presented by the global climate change agenda, particularly in connection with opportunities relating to a range of information, tools, technical assistance and project funding.*

6.2.1.5. Cross-sectoral cooperation and coordination

During the ICA the level of cooperation between institutions was identified as not being strong enough and requiring further strengthening. Republic of Moldova hasn't put yet in place a coordinating mechanism to address climate related challenges however, efforts are put to conceptualise and operationalize it. While the Government provides for clear lines of communication and authority within individual institutions and agencies, cross-sectoral coordination of information and strategies is not a strong one. In addition, existing national government's organizational structure exhibits duplication and policy gaps as well as programmatic fragmentation. These impediments represent a major constraint on the ability of the national government to link environment and development strategies with climate change impacts (Tab. 6-13). Efforts are put to move toward more coordinated and integrated approaches to climate change adaptation. Improving horizontal (cross-sectoral or agency) as well as vertical (between national, local government and communities) integration and coordination is crucial to development of more systematic responses to climate change problems.

Table 6-13: Summary on Cross-Cutting Gap Analysis

Sector	Systemic	Organizational	Individual
National Development Policies	Climate change and adaptation are poorly mainstreamed into national development strategies.	Reporting on climate-related issues is not consolidated. The adaptation-related "portfolio" is not seen from a holistic approach.	Decision-makers are unaware of adaptation issues or do not perceive adaptation as a development issue.
Economic and Sectoral Development Policies	Laws in climate-sensitive sectors do not address climate change and adaptation as an integral aspect of the sector.	Ministries and other agencies in climate-sensitive sectors do not have a legal mandate to conduct work on adaptation.	Decision-makers are unaware of adaptation issues or do not perceive adaptation as a development issue.
Environment Policies	Climate related strategies are in their early stages and are not yet reflected in sectoral policies; and are not integrated in the NDS.	Restructuring and shifts in program mandates often lead to low availability of program-related information. Need to prepare compelling budget requests that explain the development linkages of environmental programs.	Decision-makers and staff lack specialized knowledge to design and implement climate change adaptation programs.
Public Admin/ Public Management	Institutional reorganizations lead to lack of continuity; loss of data, reports, and institutional memory. Climate change adaptation portfolio (and climate change in general) is not evaluated or monitored. Lack of ongoing support for adaptation initiatives leads to continuity gaps.	Government agencies may report on program implementation but not necessarily incorporate lessons learn into program design. Unclear alignment between agency budgeting and policy priorities.	Sectoral agencies may lack the skills to analyse the data they collect and they use the findings from adaptation-related projects. Staff often lack specialized training or mentoring

Sector	Systemic	Organizational	Individual
Gender and Vulnerable Groups	Climate change and climate change adaptation are not mainstreamed into legislation on human health and related social services	Limited coordination between sectors and the National Bureau of Statistics hinders the development and promotion of gender integrated policies. Limited understanding within government and lead agencies on the need for integrating gender and other social considerations into policies and programmes	Low level of awareness about climate adaptation and related practices hinder development of community resilience
Disaster Risk Reduction	Climate change and climate change adaptation are not mainstreamed into legislation on disaster preparedness	The Commission for Emergency Situations does not have a mandate to work directly on climate change and climate change adaptation issues	Low level of awareness about disaster risk reduction practices that may improve adaptive capacity
Communication and Public Awareness	Absence of guiding policies and/or strategies on communication and awareness raising	Limited understanding within government and lead agencies on the need for communication and awareness raising	Low level of awareness about communication practices that may improve community resilience
Knowledge Management	Absence of guiding policies and/or strategies on knowledge management	Limited understanding within government and lead agencies on knowledge management	Not reviewed

The main systemic level impediments to effective use of multi-level and multi-sector climate change coordination mechanisms to address climate change impacts and strengthen adaptive responses:

- Lack of an over-arching national climate driven mandate for coordination of national strategies and priorities;
- Limited number of national climate change policies and strategies and limited references to them make coordination difficult, *ad-hoc* and project driven;
- Limited use of criteria and indicators to guide and monitor the work of coordination teams;
- A link between climate change coordinating mechanisms and other national coordinating mechanisms has yet to be established.

Under development *Climate Change Adaptation Coordination Mechanism* that responds to existing cross-sectoral coordination needs is presented in the Chapter 6.4.

The capacity constraints and impediments identified within Institutional Capacity Assessment (ICA) which are faced by the Republic of Moldova and impedes the country to effectively respond to climate change impacts are summarised above in Table 6-13.

6.2.2. Capacity development plan and sectorial adaptation needs

Based on the identification of gaps, barriers, institutional impediments and vulnerability factors, identified during the Institutional Capacity Assessment of seven key sectors of the Republic of Moldova, a two-pronged approach to developing and strengthening institutional capacity and adaptive responses was applied in order to develop a *Capacity Development Plan* (CDP), including technical and financing needs:

- to develop and strengthen the *enabling institutional capacity* including policies, strategies, legal frameworks and support the development of an effective lead agency, as well as developing a good level of awareness and understanding of climate change issues. This will provide the enabling environment to progress the needed measures to address climate change impacts. Within this overarching arc, the focus of the CD interventions should be on addressing gaps related to *Coordination, Institutional Change and Budget Mainstreaming.*
- the development and strengthening of *adaptive institutional capacity* including; enhancing collective, integrated and coordinated action, strengthening systems, networks and capacity of a broad range of actors and stakeholders to undertake climate related work and strengthen knowledge management. This approach has the potential of involving a wider range of stakeholders over a relatively shorter period of time in an inclusive, sectorial and vertically integrated mechanism. Within this overarching arc, the focus of the CD interventions will be on addressing gaps related to *Climate Awareness, Human Resources and Risk Management Information and Technologies.*

The CDP intends to address the above-mentioned needs in a comprehensive way, considering that responses to increasing climate variability require development of adaptive capacity including human and social capital, strengthening of institutional systems, sound management of public finances and natural resources, technical capacities. Institutional capacity is vital to turning climate change challenges into opportunities for development.

Key sectors and institutions have started their engagement in the National Adaptation Planning process and some sectors provided necessary entry points for integration of climate adaptation into development planning.

Institution capacity is one of the preconditions for successful mainstreaming of climate change adaptation into sector development planning. Based on the undertaken assessments at the sector level (ICA), identifying institutional capacity constraints and impediments faced by the Republic of Moldova to effectively respond to climate change impacts, a *Capacity Development Plan* (CDP) was prepared reflecting country's needs with regards to sectoral and cross sectoral capacities and priority capacity building actions to be implemented. The capacity development (CD) were made on the basis of the priority needs as they emerged from the ICA and consultation process with stakeholders with a focus on the most urgent measures and the foundational components of adaptive institutional capacity.

The CD response aims to initially leverage existing knowledge of climate risks, followed by proactive reactions to projected risks. This response is anchored in six pillars that respond to the identified challenges and priority CD needs. Combined, these six pillars are expected to contribute towards strengthening capacities of these institutions that are then expected to contribute to the development of adaptive capacity and a more effective delivery of basic services. The response plan is based on a strong focus and emphasis on strengthening and catalysing all the components of "adaptive institutional capacity" in the short- to medium-term. As such, the identified entry points for the CDP are inter-connected and each adds value to the others.

The CDP contains activities to be implemented according to the timeframe of the existing national policy framework, which doesn't go beyond 2025 year. The recommended in the CDP activities are to be embedded into the sectoral and national development plans and addressed on annual or 4 year bases depending on the scope of the activities. At the same time the planning has to allow the flexibility of addressing ad hoc requests, along with long-term perspectives of CCA. The MoEn, as leading institutions, along with line ministries is to manage and oversee capacity building work, as well as elements that are emerging during the implementation of the NAP. When dedicated Government Decision on Climate Change Coordination Mechanism, Monitoring and Evaluation framework will be enacted, supervision activities will be taken over by the National Commission on Climate Change.

Proposed Pillars and Actions

Based on the identified capacity needs, the CDP is organized around six pillars that will support achievement of the desired outcomes (Fig. 6-10):

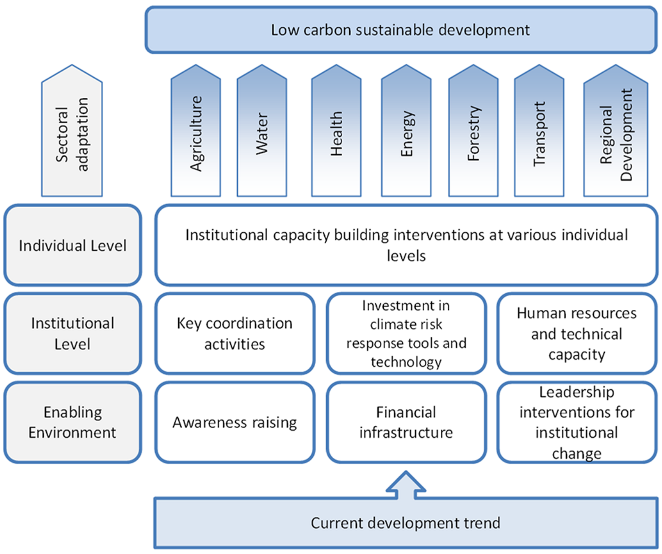


Figure 6-10: Proposed capacity development pillars to support climate change adaptation in the Republic of Moldova.

Coordination: The development of an effective cross-sectoral coordination mechanism is of the most effective strategies to engage in a broader and long-term climate change adaptation strategy, an issue that has been identified during the ICA. Coordination is to be set around (i) the need for a competent national coordination hub that would be independent and can act in a cross sectoral manner; (ii) the importance of horizontal communication and knowledge management, especially, but not only in the public sector; and (iii) the imperative to better integrate and engage the local and regional level with the national level. The positioning and profile of this mechanism is of vital importance for the long-term success of integrating climate considerations into the other planning processes in the Republic of Moldova and for increasing information sharing between institutions and sectors.

Climate awareness: At this point civil servants lack ownership of climate change and climate adaptation and there is still a lack of awareness, a lack of finances for projects, a need for capacity building, a need to enhance institutional capacities (due to silos, overlap, lack of coordination, etc.) and the need to integrate climate adaptation across sectors.

Institutional change: The introduction and integration of climate considerations into the daily business of departments and institutions of the Republic of Moldova's governance can be seen as innovation. For the innovation to succeed, institution must become a learning organization. This starts with leadership and technical staff capacity. Staff should be able to fully trust senior management and credibility is crucial for establishing trust. Leaders have to demonstrate technical competence, enabling staff to trust that they have sufficient skills to make sound decisions. Thus, strengthening technical capacities for integration of climate considerations also implies investing in leadership styles. In the initial capacity development stage this is reflected in training and awareness rising among decision makers and technical staff to develop foundational capacity.

Human resources: Strengthening capacities implies the availability of skilled and knowledgeable personnel. Typically, strengthening human capacities is associated with training and development. In the case of mainstreaming climate considerations, these interventions will be aimed at increasing technical knowledge and skills and providing the competency to use decision-making tools. It is also important to strengthen non-technical skills such as making effective linkages with external partners, and improving communication skills and project management abilities.

Risk management information and technologies: Development is needed of a more systematic approach to furthering existing DRR and climate related information, tools and technologies. Information and tools can help decision-makers and vulnerable populations better prepare and cope with the risks caused by the effects of climate uncertainty. It is important to broaden their use to support additional sectors, especially at the regional and local level, and to support achievement of climate related targets.

Mainstreaming (Budget): Climate adaptation comes at a cost therefore, investments have to be made. The perception that it is important to act on climate risk is decisive for the availability of funds. Strengthening climate related capacity could also aim at fiscal measures and control, which would provide additional financial incentives for mainstreaming. It is therefore important that the coordination mechanism have enough authority to address such issues at an appropriate level

6.2.2.1. Cross-cutting sectorial capacity and financial needs

The following represents the activities identified to be of greatest importance in meeting the overall objectives of driving the process of mainstreaming climate change adaptation into development planning of the Republic of Moldova and in supporting climate adaptation within the framework of the National Adaptation Planning process (Table 6-14).

Table 6-14: Idntified Cross-Cutting Sectoral Needs

Capacity	Identified need	Intervention needed	Indicators	Responsible Lead Agency	Estimated resources required (in USD)
Capacity Development at Enabling Environment Level					
Leadership and coordination mechanism	Establish an effective coordination mechanism for climate adaptation	Effective coordination mechanism, with regularly convened progress review meetings	Operational coordination mechanism with clear roles and responsibilities established as part of National Adaptation Planning Process	MoE until National Adaptation Framework approved and actual responsibility assigned	300,000
		Establish a coordinated M&E system			
		Identification of the authority responsible for climate policy coordination as well as monitoring, evaluating and reporting on the climate change adaptation measures	Publication and sharing of annual progress report(s) on climate resilience and adaptation activities Improved cross sectoral coordination		200,000
Institutional and legal framework	Formulate strategy to lobby high-level decision makers to address climate integration at national level	Prioritization and integration of climate considerations in the policy documents that set out the objectives of implementation the country for the programming period up to 2020	Relevant national documents completed or updated	MoE and relevant ministries	n/a
	Review and strengthen legislation, policies, action plans and development plans to improve the integration of climate adaptation in national development strategies, plans and programs	Incorporate climate adaptation into relevant sectoral policies	Relevant national and sectoral documents completed or updated	All ministries and sectors	To be identified depending on the number of reviewed policies , development plans
	Review and strengthen MoE climate related capacities, including CCO mandate and capacities	Improved and expanded MoE climate related capacities	MoE need and capacity assessment completed and operational requirements determined CCO budget and staffing integrated into ministry budget requirements	MoE	To be determined by MoE following evaluation of needs and requirements
Budget mainstreaming	Develop options for climate resilience and how to best formulate budget lines for climate resilience in the national plans and annual Ministerial Strategies	Climate considerations integrated in budget for ministries and sectors and through financial strategy for national adaptation plan	Climate considerations integrated in budgets of all government institutions with specific	MoF with support from MoE	100,000
		Climate change indicators incorporated into planning and budgeting frameworks to ensure accountability	Climate change indicators for planning and budgeting frameworks developed Climate change indicators incorporated into policy and budget reviews	MoF and MRDC	100,000
		Incorporate contingency budgets in each sector for specific adaptation interventions as the need arises	Contingency budget in each sector for specific adaptation interventions	MoF	100,000
Risk management information and technologies	Develop a climate related knowledge management strategy	Knowledge management strategy in place with a clear role for ICT focused on improving community resilience	Relevant document completed	MoE with support from technology office	100,000
	Systemic inventory of existing and *ad hoc* DRR and climate information, tools and technologies, as well as agency functions and responsibilities Transposition of DRA EU Guidelines into legislative framework: Hazard and risk mapping	Mapping and systemic inventory of existing and *ad hoc* DRR and climate information, tools and technologies, as well as agency functions and responsibilities Modification of current legal framework	Low-cost, user driven ICT systems in place. Climate data widely available and updated regularly by responsible institutions Establish a multi-stakeholders working group on DRA legal and institutional framework Further elaboration of the methodology for hazard assessment contained in the *"Recommendation"* in order to be fully in line with DRA EU Guidelines and MSs good practices.	MoE with support from technology office CPESS (coordinator working group) Working Group on Disaster Hazard and Risk Mapping	200,000

Capacity	Identified need	Intervention needed	Indicators	Responsible Lead Agency	Estimated resources required (in USD)
	Evaluation of current data collection and dissemination practices and experiences	Evaluation and documentation of lessons and best practices related to current practices and experiences	Lessons learnt document that collates and disseminates climate related information requirements	MoE with support from technology office	20,000
	A demand-based climate and disaster technology and tool in place to guide investment in and use of new tools and technologies.	Establishment of low-cost, user driven ICT systems in place. All systems are open source and publicly accessible and a monitoring and yearly usability check process established	Operational ICT system whose use has been integrated into all sectors	To be determined by the climate related knowledge management strategy	300,000
Climate awareness	Develop a five-year communication strategy to generate and increase awareness	Communications package on national policies and strategies for use during community consultations and awareness raising programs	Increased climate awareness measured against baseline survey	MoE	200,000
	Increased sectoral climate awareness	Develop sector-based guidelines on mainstreaming climate change	Sector-based guidelines on mainstreaming climate change developed and distributed	MoE	10,000 per sector
Capacity Development at Organizational Level					
Mainstreaming	Incorporate climate adaptation into environmental impact assessments guidelines	EIA process guidelines	Completed integration of climate considerations into EIA process guidelines (currently under development)	MoE	15,000
	Analytical process to examine policies, plans or program from a climate perspective for each sector	Sector-specific climate screening tools to identify projects at risk criteria for selecting projects for implementation and financing	Climate screening tools to identify projects at risk Number of projects that incorporate climate considerations Prioritized (annual) list of climate related resource requirements	MRDC with support from MoE	30,000
	Priorities and approaches for climate related sectoral development planning	Sector based approaches for integration of climate issues into sectoral development plans	Sectoral climate priorities established Relevant documents completed	MoE with relevant line ministries	30,000 per sector
Climate awareness and mainstreaming	Key messages for the different groups/sectors about climate resilience	Formulate a set of key messages for the different groups/sectors about climate resilience and the specific actions that can be taken immediately	Relevant documents completed and programs initialized	MoE with relevant line ministries	15,000 per sector
		Climate related sectoral risk profiles	Climate related sectoral risk profiles completed and programs initialized	MoE with relevant line ministries	20,000 per sector
		Sector based adaptation plans in place	Sector based adaptation plans completed and programs initialized	Relevant ministries with support from MoE	30,000 per sector
Climate knowledge and training	Sectoral training institutions mapped and climate related training programs developed	Map and identify sectoral training institutions and develop climate related training programs	Number of sectoral education programs that can incorporate climate change identified List of needed resources for development of CCA education programs	MoE in conjunction of Ministry of Education	60,000
		Climate considerations integrated in sectoral education curricula	Number of sectoral education programs that integrate climate into curricula	MoE in conjunction of Ministry of Education	80,000 per program curricula
	Training for staff on leadership, coordination, mainstreaming, communication and project management	Identify/designate mentors and coaches among officials/staff	Established roster of trained climate mentors and coaches for each sector to provide training and advisory support	MoE based on discussions with relevant ministries and sectors	100,000
		Train identified mentors and coaches on climate issues	Number of participants in mentors and coaches trainings	Initially to be conducted by MoE	60,000 per training session
	Develop climate training modules	Develop climate training modules	Training modules developed and used	MoE	40,000 per module
	Training on leadership and mainstreaming for officials and policy makers	Training on leadership and mainstreaming for officials and policy makers	Number of policy makers and sectors participating in trainings	MoE	50,000 per session

Capacity	Identified need	Intervention needed	Indicators	Responsible Lead Agency	Estimated resources required (in USD)
	Training on change, climate risks and vulnerability with the Academy of Public Administration	Training for civil servants on climate policy and climate considerations	Number of civil servants participating in trainings	MoE with support from MRDC	10,000 per person
		Training for local governments on opportunities for making use of climate policy and conducting vulnerability assessment activities	Number of local governments that participated in trainings	MoE with support from MRDC	50,000 per class/ session series
Spatial planning	Mapping settlements vulnerable to flooding, landslides and other hazards	Mapping of vulnerable settlements	Settlement vulnerability maps available to all sectors for incorporation into sectoral action plans Map of vulnerable settlements	MoE in conjunction with MRDC	150,000
		MRDC initiates integrated planning around geographically vulnerable areas to produce high-quality development plans for disaster-prone areas			
	Review, update and develop urban and spatial plans of localities	Updated urban and spatial plans of localities	Updated urban and spatial plans of localities	MRDC	40,000 per locality
	Develop codes and regulations for limiting of residential and commercial facilities and homes in areas vulnerable to hazards.	Codes and regulations for residential and commercial facilities and homes in areas vulnerable to hazards	Codes and regulations for residential and commercial facilities and homes in areas vulnerable to hazards	MRDC	n/a
	Develop urban and rural post-disaster redevelopment plans	Post-disaster redevelopment plans		MRDC with support from relevant line ministries	40,000 per locality

6.2.2.2. Sector specific capacity and financial needs

Since the majority of needs identified in the ICA are essentially national level ones, the recommended sector specific activities are considered of utmost priority for supporting each sector's ability to adapt to climate change. The options and opportunities listed below are focused on the more urgent measures and the components needed to strengthen sectors' adaptive capacity. Each recommendation is considered of utmost priority for supporting that sector's ability to adapt to climate change and develop strong foundations for additional adaptation activities.

In 2016 the World Bank has carried out an economic analysis of mid-to-long term climate adaptation investment needs in several sectors. The Report *"Moldova Climate Adaptation Investment Planning Technical Assistance"*[190] states that adaptation investments totalling $ 4.22 billion needed to mitigate climate impacts, with around $ 1.85 billion considered as relatively higher priority in the near-future. A summary of the findings from the report, including indicative economic returns, relative uncertainty in benefit and cost calculations, and qualitative implications for poverty and gender, are shown in Table 6-15.

[190] WB Report "Moldova Climate Adaptation Investment Planning Technical Assistance" 2016, 88p

Table 6-15: High Priority Investments in Moldova economy sectors through 2040 assessed by the World Bank

Sector	Investment	Investment period	Cost	Indicate Rate of Return	Uncertainty of C&B[191]	Poverty impact	Gender impact
Agriculture Water Management	Rehabilitate/modernize centralized irrigation systems	2017 to 2040	975.0	IRR: 8% to 15%	Medium	Medium	Medium
	Rehabilitation/modernization of drainage infrastructure in irrigated areas	2017 to 2026	120.0	IRR: 8% to 15%	Medium	Medium	Medium
	Institutional reforms/capacity building	2017 to 2024	140.0	n/a	Medium	High	High
Forestry	Ecological reconstruction of forests	2020 to 2029	91.3	IRR: 3% to 14%	Medium	High	High
	Ecological reconstruction of forest belts	2020 to 2029	4.9	IRR: 4% to 15%	Medium	High	High
Health	Heat health warning system	2017+	0.4[192]	BCR: 3.1-170	High	Medium	Medium
Water Supply	Improving municipal & industrial water system efficiency by 10% reduction in losses	2017+	2.8-5.5	BCR: 61-70	Low	Medium	Medium
	Water storage in Lower Nistru (100 MCM)	2030+?	18.4	BCR: 2.6-6.4	Low	Medium	Medium
	Water storage in Raut (1 MCM)	2020	0.3	BCR: 20-59	Low	Low	Medium
Flood Prevention	Structural measures	2020-2040	360.8	BCR: 2.1	Medium	Unknown	Unknown
	Non-Structural measures	2020-2040	136.6	BCR: 5.6	Medium	Unknown	Unknown
WSS	Rehabilitation of existing and construction of new WSS infrastructure	2020-2040	409 [350-439]	BCR: 2.5-3.2	Medium	High	Medium
Disaster Response Management	Improved training facilities; Create N&S Emergency Command Centres; Improved emergency response capabilities	2020	11	BCR: 2.1-4.1	Medium	Medium	Medium

[191] Ratings are given here for the significance of uncertainty of benefits for each investment Red = high uncertainty, amber = medium uncertainty, and green= low uncertainty.
[192] Costs incurred in years of a heatwave.

The key priorities by sector identified during the assessment are:

- Agriculture: Rehabilitation/modernization of centralized irrigation systems and drainage infrastructure will make a major contribution to increasing current productivity and mitigating future climate impacts. These are expected to have good rates of return as long as they can be combined with successful institutional capacity-building for management of irrigation systems. Other options include small-scale on-farm irrigation systems, soil management and climate risk management technologies (e.g., anti-hail nets), and the potential for changes in crop mix towards perennial crops (i.e., grapes and fruit trees), which will be more resilient to climate change.
- Forests: Ecological rehabilitation and expansion of forests and forest belts are expected to have high returns on suitable land, and to have a high poverty and gender impact. Restoration of degraded forests and pasturelands also promotes agricultural productivity through improved watershed function and protection from harsh weather.
- Human Health: Although there is uncertainty around the scale of climate-related health impacts, modest investments in heat warning systems and public health campaigns are expected to have high returns.
- Water: Improvement in municipal supply systems to reduce losses, and building a small-scale storage reservoir on the lower Nistru River, present immediate, modest investment opportunities with high return. In coming decades, larger-scale storage infrastructure will be needed. The ideal size and timing of these requires more analysis, and the institutional capacity to effectively manage a variety of water investments would also need to be strengthened.
- Flood Control: A substantial set of structural and non-structural measures for flood control is expected to provide substantial economic returns from the reduction of damages and loss.
- Disaster Risk Management: A set of modest investments is expected to provide key gains for public safety as well as substantial economic returns, i.e., improvements to emergency prevention and preparedness, including training facilities, new Emergency Command Centres in the North and South, and improving emergency response capabilities.

A more thorough analysis of sector specific needs for climate change adaptation planning and implementation is given in the Table 6-16.

Table 6-16: Identified Sector Specific Needs for Climate Change Adaptation in the Republic of Moldova

Identified need	Indicators	Responsible Lead Agency	Estimated Resources Required (USD)	Timeframe
Water Resources Sector				
Complete appropriate sectoral legislation, especially the harmonization of the legal and institutional framework with European requirements;	Sectoral legislation completed and harmonized legal framework with EU requirements	MoEN, MAFI	35,000	2018
Review and update regulations, codes and technical standards of design, construction, modernization and rehabilitation of hydro facilities to address and include climate considerations	Updated regulations and technical standards	MoEN, MEC	35,000	2018
Conduct studies to assess the available water resources, determine their vulnerability to climate change, water requirements and needs for the main categories of consumers. Support foundational capacity building and targeted research needs for joint, ecosystem based management of trans-boundary water systems	Studies and research conducted	MoEN, ASM	70,000	2017
Assure availability of water at source through the development of the infrastructure for transforming water resources into socio-economic ones	New accumulation lakes created, infrastructure for collecting rain water created, wetlands developed	MAFI, MoEN	140,000	2020
Assure the integrated water management based on river basin principle	Water quality criteria established, wastewater treatment process improved, regulations on the limitation of emissions of hazardous substances into water established	Moldsilva Agency	360,000	2020
Adopt ecosystem-based approach to manage water resources	Ecosystem based approach embedded into sectoral planning process	Apele Moldovei Agency	35,000	2020
Update the water sector National Development Plan to include risk reduction (floods, droughts, landslides, etc.), and include (1) risk assessment; (2) definition and risk management; (3) investment planning and water recovery	National Development plan updated based on the assessments undertaken	GoM	120,000	2020
Undertake measures to combat drought/water scarcity	Monitoring and warning services provided, leakages in water networks reduced, mapping and drought thresholds established, water storage capacity created	MoEN MAFI	4,300,000	2020
Innovative solution implemented for improved water efficiency Improve prioritization of issues (and policy-based budgeting) and program oversight	Water management innovative solutions implemented	MoEN, MAFI	9,000,000	2020
Assure the integrated water management based on river basin principle Increase linkage between policy, functional programming and budgeting	Water quality criteria established, wastewater treatment process improved, regulations on the limitation of emissions of hazardous substances into water established	"Moldsilva" Agency	360,000	2020

Identified need	Indicators	Responsible Lead Agency	Estimated Resources Required (USD)	Timeframe
Ensure proper management of flood risks	km of protective dams re-constructed/ constructed, flood forecasting, information and alert systems created	MoEN	140,000	2020
Agriculture Sector				
Identification of vulnerable areas and sectors and assessment of needs and opportunities of alternative crops and varieties more resistant to change in response to climate change	Study on areas of identified needs and opportunities developed	MoEN, ASM	140,000	2017
Promote and implement Soil Law	Soil Law adopted by the GoM	MAIF	35,000	2020
Support to adaptation and mitigation of climate changes effects on agricultural production	Risk management tools including agricultural insurance should be supported in order to mitigate the negative consequences of climate risks and the negative effects of natural disasters on agricultural production and competitiveness of farming	MAFI	150,000	2020
Develop an agricultural subsidy system that based on farm compliance with integrated environmental management	Subsidy system operational	MAFI		post 2020
Develop a program of measures to conserve water in the soil and adjustment periods for conducting agricultural activities on climate change	Programme of measures to be developed, activities performed	MAFI	140,000	2018
Capacity building for adaptation to climate change through awareness of stakeholders using the FAS and supply essential information on farm management	Information campaigns organized, advice, information published	MAFI	430,000	2020
Implement crop breeding programs based both on traditional techniques and modern biotechnology to identify strains with traits better suited to the new climate conditions	Funds identified, program in place applying both modern and traditional techniques	MAFI	720,000	2020
Strengthening the scientific studies and researches in the field of irrigation of agricultural lands using modern innovative irrigation technics	Scientific studies in the field of irrigation carried out.	AS RM	70,0000	2020
Developing irrigation plans based on an assessment of their impact, future water availability and water needs, taking into account supply - demand balance	Plans developed and approved	MAFI, MoEN	100,000	2018
Creating tools for risk management and crisis to cope with the economic consequences of events due to climate	Risk management tool created	MAFI, MoEN	360,000	2019
Human Health Sector				
Implement an efficient Health Information System (HIS) for decision making and public access to environmental health data	Working group established, approved procedures	MH	200,000	2020
Ensure an efficient mechanism for prevention, early warning, management and control of extreme weather events effects	Mechanism for early warning, management and control of extreme weather events effects.	MH	800,000	2020
Reduce the effects from air pollution and cold waves on population health	Measures to reduce air pollution and cold waves on population health applied	MH, MoEN	100,000	2019
The establishment of an integrated and efficient system for prevention, early warning, management and protection against ultraviolet radiation increased levels	Early warning system operational	MH, SHSM	50,000	2020
Provide increased access for isolated communities and vulnerable populations to health care	Mechanisms to provide access to vulnerable populations created, established	MoH	3,000,0000	2018
Evaluate the existing disease surveillance systems and strengthen them by including certain climate-caused consequences	Disease surveillance systems improved and consolidated	MoH	140,000	2018
Increase public information and raising awareness about impact of climate change and extreme weather on health;	Constantly operational information system in place.	MoH	100,000	2020
Develop a plan to address care for vulnerable population groups (elderly people, isolated people, people without a place to live, etc.) in case of health and climate emergencies	Plan developed	MoH	50,000	2019
Strengthen primary health care (including primary prevention) services to support capacity of local communities to become resilient to climate-related health risks	Primary health care service support resilient to climate changes	MoH	100,000,000	2020
Create the national database for collecting and processing data and information of effects of climate change risks onto public health	Database established and accessible for use	MoH	100,000	2019
Energy Sector				
Promote renewable energy sources that operated based on environment-friendly technologies	Photovoltaic generators, wind facilities, biomass heated facilities used	MEC, MoEN, EEA	80,000,000	2020
Promote the gradual transition from the use of traditional fuel sources to biofuel use	15% of the used fuel will be biofuel, Standards and technical regulations implemented	MoEN, MEC, MTRI	140,000	2020
Promote the efficient energy use and promote high energy efficient products	Energy intensity reduced by 10% 2% of energy efficiency assured every year	MEC; EEA	34,000,000	2020
Improve the sustainability of energy transmission and distribution infrastructure	Inspection of vulnerable infrastructure, of electrical cables buried, re-rated	MEC	7,200,000	2020
Increase training of additional reserve maintenance teams and ensure viability of their full repair kits and other equipment	Training provided to maintenance team	MEC	35,000	2019
Adaptation measures implemented through mainstreaming into sector development strategy	CCA measures implemented through mainstreaming into development plans	MEC	117,520	2030

Identified need	Indicators	Responsible Lead Agency	Estimated Resources Required (USD)	Timeframe
Transport Sector				
Harmonize transport legislation with EU requirements	Whole sector legislation and codes harmonized with EU legislation	MTRI	200,000	2018
Assure the design of road infrastructure taking into account the need to adapt to climate change	Regulations, standards approved	MTRI	105,000	2020
Assure the planning of urban transportation system in view of creating the needed infrastructure to promote the alternative transportation such as cycling	Infrastructure created for cyclists in urban area	MTRI	360,000	2019
Review and amend sectoral policy documents (strategies, plans, programs) to address climate change risks and identify highly vulnerable assets	Policy reviewed, vulnerable assets identified	MTRI	35,000	2018
Assure the sustainability of transport infrastructure through the use of materials resistant to temperature fluctuations, floods	Regulations, standards approved	MTRI	350,000	2017
Develop process and mandate for channelling funds from the Road Fund towards sector based climate change risk research, impact assessment, capacity building, planning	Process and mandate developed	MTRI	40,000	2020
Adaptation measures to be implemented through mainstreaming into sectoral development Strategy	CCA measures implemented through mainstreaming into development plans	MTRI	14,500,000	2023
Forestry Sector				
Update national legislation related to the forestry sector, including in the context of harmonization with EU legislation, international conventions and agreements	Legislation updated and harmonized with EU legislation, international conventions	Moldsilva Agency; MoEN	35,000	2018
Enhance the process of scaling-up territories covered with forest vegetation and ecological restoration of forests, create interconnection corridors between forests	130,000 ha of woodland, green islands created	Moldsilva Agency; MoEN	720,000,000	2020
Develop a protection and management system of existing forest land	Management system of protected land developed	Moldsilva Agency	35,000	2020
Establishment of national forestry monitoring system	Monitoring system developed and in place	Moldsilva Agency, MoEN	35,000	2020
Creation of new forests adapted to the consequences of climate change and able to effectively capture carbon and produce wood biomass	New forests planted and level of adaptation measured based on specific indicators.	Moldsilva Agency	1,500,0000	2020
Develop assessment process for monitoring forest plantations along water courses	Assessment methodology developed and applied in practice	Moldsilva Agency	35,000	2018
Develop and implement river basin level management plans for water resources that include climate considerations	River basin management plan developed and implemented	Apele Moldovei Agency, MoEN, SHS	1,500,000	2020
Adapting forest regeneration practices to the needs brought by climate change	Regeneration practices in place	Moldsilva Agency	40,000	2020
Ensure the protection and conservation of biological diversity	Protection and conservation measures implemented. Developed indicators that to monitor adaptation state of the ecosystems developed	MoEN	700,000	2020
Promoting awareness and good understanding on climate change and on how the forestry sector can make a positive contribution	Awareness raising campaign and training provided	Moldsilva Agency	25,000	2016
Regional Development Sector				
Develop the guidelines for mainstreaming of climate change adaptation in sector plans and budgets and in regional and local development plans	The guidelines developed and used in CCA mainstreaming in plans and budgets	MCRD	5,000	2017
Develop of the baseline and targets for climate change adaptation in the three development regions	Targets and baseline for 3 development regions.	MCRD	20,000	2018
Increase linkage between central, regional and local government actions on climate change	Coordination mechanism between central, regional and local government actions setup		10,000	2019
Develop a resources platform and a network of experts in „climate change" (independent experts, NGOs, scientific institutions, financial institutions), which could provide climate change adaptation services to local public authorities	Resource platform and experts platform operational	MCRD	35,000	2020
Develop local level tailored policies and legislation	Local level tailored policies and legislation developed	MCRD, MoEN	50,000	2016
Develop climate risk management strategies for three development regions	Climate risk management strategies developed	MCRD, MoEN	15,000	2018

Climate Change Adaptation Investment Planning Status Report[193] of the MoEn and WB to the International Development Association (draft) proposes a simplified adaptation framework (Table 6-17) based on WB assessment, proposes to focus on nine priority investment categories over the period from now through 2025, or just beyond the end of the next phase of sector strategies and DP frameworks.

[193] MoEn and WB: Climate Change Adaptation Investment Planning *Status Report to the International Development Association*

Table 6-17: National Priority Climate Adaptation Investments through 2025 based on WB assessment[194]

Sector	High Priority Investment	Working Estimates (2017-2025 total)	Budget Rationale	Comments
Cross-sector	Establish institutional frameworks; coordinating bodies; M&E; outreach	$4 million	Based on S0#1 and #2 in NAP[3] without financing elements in 1.3.5 & 1.3.6	Includes mainstreaming and capacity-building
Agriculture	Expand rehabilitation of centralized irrigation systems	$100 million	Includes increase system coverage by 100% over MCC-supported project	Very cost effective given improved production
	Agricultural research and planning	$20 million	Based on NAP items in 3.1	Estimates in NAP are too low; this budget is almost many times higher
Forestry	Afforestation, shelter belts, enforcement and governance	$65 million	Considering Forestry AP and WB TA	Forestry AP is still in draft stage; assuming shift to more resilient species
Water	Flood control	$100 million	Based on EIB study	Reflecting near-term priority needs
	Reducing water loss in public systems	$20 million	Based on NAP items in 3.2; WB TA	Does not include upgrading of national WSS systems which could >$400 million
Health	Improved disease surveillance, monitoring and response	$12 million	Scaling up from suggestions in Draft Health AP and WB TA	Health sector Action Plan is pending; to date there has been significant under-estimation of needs
Transport	More resilient regulations and standards; urban cycling infrastructure	$4 million	Scaling up from suggestions in NAP	May be under-estimated given additional costs for new and rehab roads
Energy	Promote energy efficiency and build resilience in transmission and distribution	$30 million	Based on NAP items 3.5.3 and 3.5.4	Does not include suggestions for renewable energy (wind and biomass)

[194] Estimates from the NAP were scaled up by a factor of 1.4 given longer time frame; conversion rate of 19.5 MDL to $1 US dollar

The figures reported in the WB report along with those mentioned in Table 6-17 indicate the enormous investments required, for a large part in physical infrastructure, but also in soft measures, such as change in institutions and policies, capacity building, and strategy development. From the analysis made it can be concluded that there are opportunities to support low-carbon and climate- resilient development in the Republic of Moldova but the needs far exceed availability and accessibility of resources.

6.2.2.3. Research and development needs to meet adaptation targets

The main policy documents that support research and innovation in the Republic of Moldova are the *Innovation Strategy for 2013-2020 "Innovation for Competitiveness"* and *Research and Development Strategy until 2020* stating the objectives related to the development of the innovations sector.

Experienced research institutes are encouraged to participate in supporting the development of the national climate change policy. Since most research institutes conduct studies only on a contractual basis, adequate financial resources are crucial for conducting climate change research, and collaborative relationships will be developed with international financial institutions as long as financial resources remain limited for a long time. A major emphasis will be placed on building the capacities of working group members for climate modelling to develop climate models and perform impact assessment studies, for example, by facilitating the exchange of experience and research visits to international climate modelling centres.

It is equally important to monitor the climate change impact and conduct research in priority sectors such as: Agriculture, Health, Forestry, Energy, Transport, Water Resources etc.

Agriculture Sector

There is a need that agriculture research to address not only change in temperature and precipitation and its impacts on agriculture, but also the interaction with hazards, directly or indirectly arising from atmospheric conditions, such as rainfall, flood, frost, drought, hail, heat waves, seasonal shifts (length of growing season, bud break, quality aspects), and changes in pest and disease patterns.

Crop specific evaluations should be conducted to determine changes in seasonal development, characteristics of production, cultivation methods, etc., under climate change.

Crop models are required to assess the impacts of climate change and increased atmospheric concentration of CO_2 on various crops, pastureland and livestock. Further, crop simulation models need to be interfaced with Geographic Information Systems (GIS) in order that these models can be applied for regional planning and policy analysis. In addition, a variety of approaches, such as economic regression models, microeconomic and macroeconomic models, and farm models should be developed and used.

Health Sector

Quantitative research is required to identify the regions of the Republic of Moldova most vulnerable to the adverse health effects of climate change. These areas will require focused adaptation measures, including better health clinics and equipment, education of the public on ways to cope with new health concerns.

Improved disease burden estimates need to be established, based on latest climate models to estimate:

- heat-related mortality statistics based on existing mortality and population data at the national level and in key cities of the Republic of Moldova;
- the impacts of projected changes in climate, taking into account various forms of acclimatization/adaptation;
- climate-water and foodborne diseases relationships using panel data on income and health to project cause-specific deaths and disability-adjusted life year (DALY) rates by demographic group.

Further in depth studies on the socio-economic assessment of climate change in the health sector would be beneficial, including:

- the health 'damage' costs of climate change under different climate scenarios;
- the costs of preventing death, illness and injury under different mitigation scenarios (i.e. adaptation measures).

Water Resources Sector

There were identified the needs to undertake specific research in:

- Defining critical thresholds in water resource;
- Improving the capacity to calibrate state-of-the art rainfall runoff models;
- Understanding of the economic and social impacts of climate change on water quantity, supply, and demand including irrigation, drinking-water supplies, recreation/tourism, hydropower and industry, and system losses.

The capacities of developing and implementing systems of hydro-economic assessment of river basin will be enhanced to assess the further development of water resources and the related sustainable development, such as hydro-electric development, wastewater treatment and irrigated agriculture.

Pre-feasibility or feasibility studies for irrigation and land use projects are needed (including from groundwater sources), and should be required to include an assessment of the physical and economic impacts of climate change;

Assessments and analyses on social, economic and environmental costs and benefits of future adaptations will be performed.

Forestry Sector

There were identified the following priorities for research:

- Establishing the climatic thresholds that correspond to the distribution limits of a forest type or species and develop a bioclimatic model to predict future steady-state forest distributions under a range of plausible climate change scenarios;
- Collecting historical analogues and life-history information to estimate how long it might take for the forest boundary to migrate a given distance;
- Calibrating a biogeochemistry model to predict changes in productivity and carbon stocks in each forest type, with and without the effects of elevated CO_2 concentrations;
- Evaluation of adaptive capacity including the inherent adaptive capacity of trees and forest ecosystems and the socioeconomic factors determining the ability to implement planned adaptation measures.

Energy Sector

For the energy sector there were identified the following areas to conduct the research:

Assessing the possible effects (both positive and negative) of climate change on energy consumption:

- effects of climate warming on energy use for space heating;
- effects of climate warming on energy use for space cooling;
- market penetration of air conditioning and heat pumps (all-electric heating and cooling), and changes in humidity;

Conducting studies possible effects on energy generation and supply:

- assessment of impact of increased temperatures and droughts on hydro energy potential;
- impacts of climate change on energy generation from biomass;
- wind resources changes (intensity and duration); and
- electricity transmission and distribution;

Research is needed in efficiency of energy use in the context of global warming, with an emphasis on technologies and practices that save cooling energy and reduce electrical peak load.

Transport Sector

Examining the long-term impacts of climate change on the Transport sector is needed in light of climate change projections to determine whether, when, and where the impacts could be consequential, particularly in light of the long planning horizons for transport infrastructure.

Analysis of options is necessary for adapting to these impacts, including the possible need to alter assumptions about infrastructure design and operations, the ability to incorporate uncertainty into long-range decision making, and the capability of institutions to plan and act on mitigation and adaptation strategies at the state and regional levels.

The promoted studies on climate change and on the vulnerability to its effects enable better knowledge about sectors, ecosystems and regions that are particularly exposed to climate change, facilitating the identification and promotion of vigorous and effective actions for mitigating the adverse effects of climate change in the country. The findings of these studies will substantiate the adoption of planned adaptation measures and will help to increase the domestic adaptation capacity in line with the achievement of objectives and national sustainable development and environmental protection priorities.

6.2.2.4. Sector specific capacity development opportunities

Capacity development is an important step towards larger outcomes. In this context, climate related capacity development at the sectoral level was framed within the context of the desired sectoral outcomes and with a focus on those specific and foundational aspects that will support long-term improvement in sectoral capacities. Since the majority of CD needs identified in the ICA are essentially national level ones, sector specific activities are considered of utmost priority for supporting each sector's ability to adapt to climate change. From the sector specific reports, the options and opportunities listed below are focused on the more urgent measures and the components needed to strengthen adaptive institutional capacity. Each recommendation is considered of utmost priority for supporting that sector's ability to adapt to climate change and develop strong foundations for additional adaptation activities (Table 6-18).

Table 6-18: Sector Specific Capacity Development Opportunities in Support of Improving the Enabling Environment

Institutional and Legal Framework	Rationalization of Organizational Structure
Regional Development sector	
• Increase linkage between central, regional and local government actions on climate change • Local level tailored policies and legislation • Contribute to the process of development of guidelines for integration of climate change in sector plans and budgets and in regional and local development plans • Develop climate risk management strategies for the different regions • Development of baseline and targets for climate change adaptation in the 3 development regions	

Institutional and Legal Framework	Rationalization of Organizational Structure
Water sector	
• Complete appropriate sectoral legislation, especially the harmonization of the legal and institutional framework with European requirements • Review and update regulations, codes and technical standards of design, construction, modernization, and rehabilitation of hydro facilities to address and include climate considerations • Develop a mechanism for compulsory insurance and compensation mechanism for climate and disaster risks • Include environmental and climate considerations in the development process of policy documents and regulatory legal framework • Develop and implement (regional and inter-local) national infrastructure development and water service plans. • Update the water sector National Development Plan to include risk reduction (floods, droughts, landslides, etc.), and include (i) risk assessment; (ii) definition and risk management; (iii) investment planning and water recovery • Improve prioritization of issues (and policy-based budgeting) and program oversight • Increase linkage between policy, functional programming and budgeting	• Streamline and clarify policies, agencies, jurisdiction and functions between water sector agencies to reduce duplication of mandates and activities • Develop a clearly defined sectoral coordination mechanism and a coordinated system for monitoring the sector, its inventories, related risks, data collection activities and infrastructure investments • Developing sector based methodology for inventory and assessment of construction and hydro facilities, the implementation of these activities and effective models for managing them in the context of climate change • Development of a clearly defined process and streamlining of organizational function regarding data collection, forecasting and monitoring of hydrometerological data
Agriculture sector	
• Create two new departments in the Ministry of Agriculture and Food Industry responsible for coordination of environment protection in agriculture (agri-environment programmes) and the production and promotion of indigenous seeds and seedlings in cultivation and genetic material for animal husbandry • Develop national food security strategy for changing climate conditions • Promote and implement Soil Law • Develop an agricultural subsidy system that is also based on farm compliance with integrated environmental management • Creating a state extension service to promote sustainable and organic agriculture • Harmonize adaptation programs within the Ministry of Agriculture and Food Industry	Streamline and clarify policies, agencies, jurisdiction and functions between the Ministry of Agriculture and Ministry of Regional Development and Construction to reduce duplication of mandates and activities on sustainable rural development and create the appropriate linkages to spatial planning processes. Consideration should be given to transferring this authority entirely to the Ministry of Regional Development and Construction.
Human Health sector	
• Improve ability to expand service network in the rural areas • Development (and ongoing assessment) of health and emergency management measures for reducing the impact of extreme events on health • Prepare a communication plan for all stakeholders containing relevant information (what, who and when) to address extreme climate events, health hazards and related operational and service needs • Develop a plan to address care for vulnerable population groups (elderly people, isolated people, people without a place to live, etc.) in case of health and climate emergencies • Develop plan to provide safe drinking water that also addresses expected changes in climate conditions • Strengthen primary health care (including primary prevention) services to support capacity of local communities to become resilient to climate-related health risks • Provide functional early warning systems related to the health consequences of climate change and climate variability	• Streamline and clarify policies, agencies, jurisdiction and functions between sectoral agencies to reduce duplication of mandates and activities • Improve implementation mechanisms, monitoring, and inter-sectoral coordination especially in the case of early warning systems for extreme climatic events
Energy sector	
• Develop climate adaptation target requirements in the legislative documents • Integrate adaptation measures and targets in the development plans of enterprises, national and sectoral plans • Increase training of additional reserve maintenance teams and ensure viability of their full repair kits and other equipment	• Improve ability to organize and create the necessary material reserves to maintain the operations during the climatic events • Improve electrical network backup capabilities
Transportation sector	
• Harmonize transport legislation with EU requirements • Review and amend sectoral policy documents (strategies, plans, programs) to address climate change risks and identify highly vulnerable assets • Develop and implement technical regulations and standards to match the requirements of international commitments and standards • Develop process and mandate for channelling funds from the Road Fund towards sector based climate change risk research, impact assessment, capacity building, planning, etc.	Improved management capacity of the public road maintenance system will allow it to address the needs created by climate change
Forestry sector	
• Updating national legislation related to the forestry sector, including in the context of harmonization with EU legislation, international conventions and agreements • Develop and adopt the concept of forestry policy document • Develop national forest management programs in the context of their climate change adaptation • Ensure implementation of the national plan for expanding forestry areas • Develop assessment process for monitoring forest plantations along water courses • Develop and implement river basin level management plans for water resources that include climate considerations.	Streamline and clarify policies, agencies, jurisdiction and functions between Moldsilva, Ministry of Environment and State Ecological Inspectorate to reduce duplication of mandates and activities regarding forestry policy and state control over related business activity

There is an urgent need to develop and strengthen institutional capacity in Moldova in light of the undertaken institutional capacity to address the impacts of climate change. Based on the identification of a range of institutional impediments and vulnerability factors, a two-pronged approach to developing and strengthening the identified institutional capacity priorities is recommended for the development of adaptive responses.

The first approach recommends to develop and strengthen the enabling institutional capacity including policies, strategies, and legal frameworks and supports the development of an effective lead agency, as well as developing a good level of awareness and understanding of climate change issues. The second approach involves the development and strengthening of adaptive institutional capacity including: enhancing collective, integrated and coordinated action, strengthening systems, networks and capacity of a broad range of actors and stakeholders to undertake climate related work and strengthen knowledge management. These further steps will be articulated in the associated Capacity Development Plan that will link and expand on the identified range of options and opportunities to strengthen the institutional capacity.

6.2.3. Capacity building with regard to climate adaptation

Capacity Building for State Hydrometeorological Service. Climate-related information, as in the form of vulnerability assessments and related data is considered the foundation for adaptation planning and climate-proofing decision making. It is important this information to be available at a good quality and sharing of such information in a timely manner as core technical challenges in reducing the risks of climate disasters. Just simply highlighting the problem is not enough convincing and useful for the policy makers to make decisions, evidences generated are to be demonstrated in the national context and support realistic solutions.

For these reasons, concentrated capacity building efforts have been directed toward improving data availability, management, public service quality and dissemination to support adaptation planning of the State Hydrometeorological Service (SHS) in line with the standards of the World Meteorological Organisation (WMO).

Capacity building activities at the SHS have been implemented under the partnership with the Austrian Central Institute for Meteorology and Geodynamics (ZAMG) with the goal to support SHS to become a member of the EUMETNET EMMA/Meteoalarm community, which is a grouping of European National Meteorological Services that provides a framework to organize co-operative programs between its members in the various fields of basic meteorological activities (Fig. 6-11). After the evaluation of the institutional and technical capacities of SHS, a roadmap toward achieving the membership of EUMETNET was developed and further activities followed the path underlined in the roadmap. These activities included SHS staff applying EUMETNET OPERA program, exchanges of weather radar data and providing weather radar data for the OPERA European composite products, legally apply weather warning code and improve the dissemination of the information to decision makers and end users in the Republic of Moldova.

Special emphasis was laid on the capacity building of the weather forecasters, IT staff and flood forecasters, on the technical and administrative support for the participation of SHS to the EUMETNET programs (EMMA/METEOALARM and OPERA). A number of basic and advanced training courses were delivered to SHS staff by ZAMG with the learning needs of state of the art analysis/forecasting and nowcasting methods, use of operational radar and satellite images, use of numerical models results. After completing this course, the SHS forecasters know state of the art forecasting and nowcasting techniques, know how to interpret radar and satellite images and to use and interpret the output of numerical weather forecast models. Further activities on the definition and adaptation of the warning parameters, thresholds and criteria, investigation of which parameters have the potential to endanger the territory and citizen of the Republic of Moldova have been implemented closely with of Civil Protection and Exceptional Situations Service of Moldova. The hydrology courses contributed to develop SHS staff skills for the generation and transfer of the flood warnings to the Meteoalarm System. The trainings were organized by ZAMG in close collaboration with the Hydrographical Service of the Province of Salzburg, the Austrian Ministry for Agriculture, Forestry, Environment and Water Management, Division IV/4 Water Management and Verbund Hydropower Company.

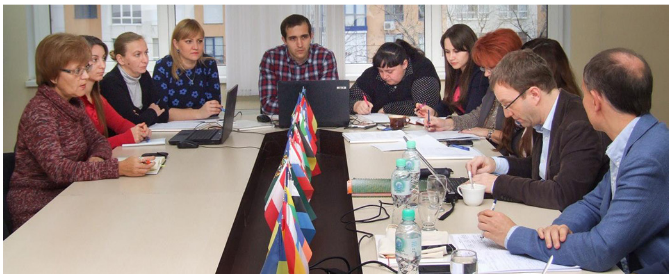


Figure 6-11. Capacity building activities at the SHS provided by the Austrian Central Institute for Meteorology and Geodynamics (ZAMG).

During the 15th EIG EUMETNET Assembly of Members 3-4 December 2015, EUMETSAT HQ, Darmstadt, the State Hydrological Service became an associate member of EUMETNET.

Another objective of the partnership was to increase SHS capacities for issuing weather warnings without external support for the EU Meteoalarm platform (Table 6-19). Specific training courses for SHS were tailored to IT staff needs on the dissemination and transfer of warnings to the Meteoalarm system: (i) planning of the advanced forecaster training course, (ii) consultation of SHSM staff regarding the preparation of the request for the participation in EMMA/Meteoalarm and OPERA to EUMETNET, (iii) IT infrastructure (supercomputer, network, virtualization, data bases) of a modern weather service at the ZAMG.

Table 6-19: Warning Parameters and Thresholds currently used at SHS for Issuing Range Weather Warnings for Meteoalarm

Phenomena	Yellow	Orange	Red
Wind	gust of 15-20 m/s	gust of 21-29 m/s	gust of 30 m/s and more
Rain	amount of 15-49 mm, accumulated in 12 hours or less	amount of 50-79 mm, accumulated in 12 hours or less	amount of 80 mm and more, accumulated in 12 hours or less
Snowfall	7-19 mm, accumulated in 12 hours or less	20-29 mm, accumulated in 12 hours or less	amount of 30 mm and more, accumulated in 12 hours or less
Thunderstorms	deep, organized and persisting convection	-	-
Blizzard and snowdrifts	wind speed of 11-14 m/s, lasting for 3 hours or more	wind speed of 15 m/s and more, lasting less than 24 hours	wind speed of 15 m/s and more, lasting for 24 hours or more
Extreme low temperature	air temperature of -24 to-20°C	air temperature of -25 to-29°C	air temperature of -30°C and lower
Extreme high temperature	air temperature of 33 to35°C	air temperature of 36 to 38°C	air temperature of 39°C and higher
Fog	visibility of 200m or less, for 3 hours or more	visibility 50m or less, lasting for 3 hours or more	visibility of 50m or less, lasting for 24 hours or more
Heavy showers	-	amount of 30 mm and more, accumulated in 1 hour or less	-
Long-lasting rain	-	amount of 100-149 mm, accumulated in 1-3 days	amount of 150 mm and more, accumulated in 1-3 days
Hail	diameter of 6-19 mm	diameter of 20-39 mm	diameter of 40 mm and more

The implemented training courses guaranteed the development of the essential skills and competences of the SHS staff required for the sustainable development of the forecasting capacities at SHS. Starting 21 December 2016, the SHS severe weather warnings were released on the operational Meteoalarm system (Fig. 6-12, 6-13).

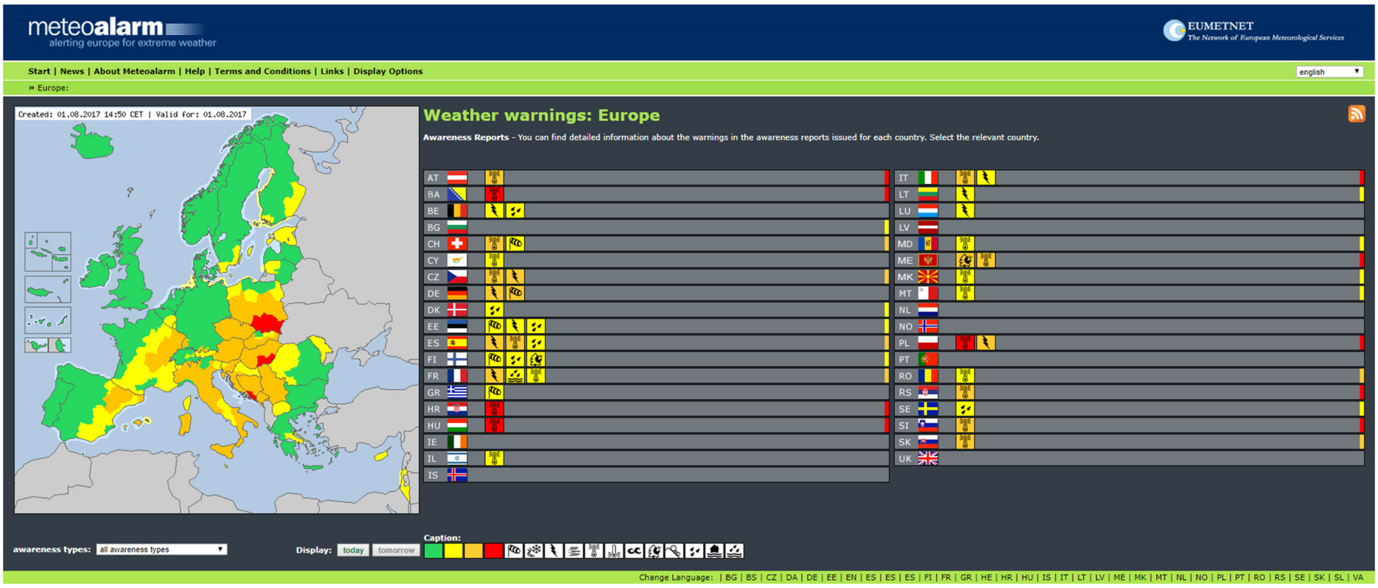


Figure 6-12: List of Countries Issuing Weather Warnings for Meteolaram System <www.meteoalarm.eu>, including Moldova.

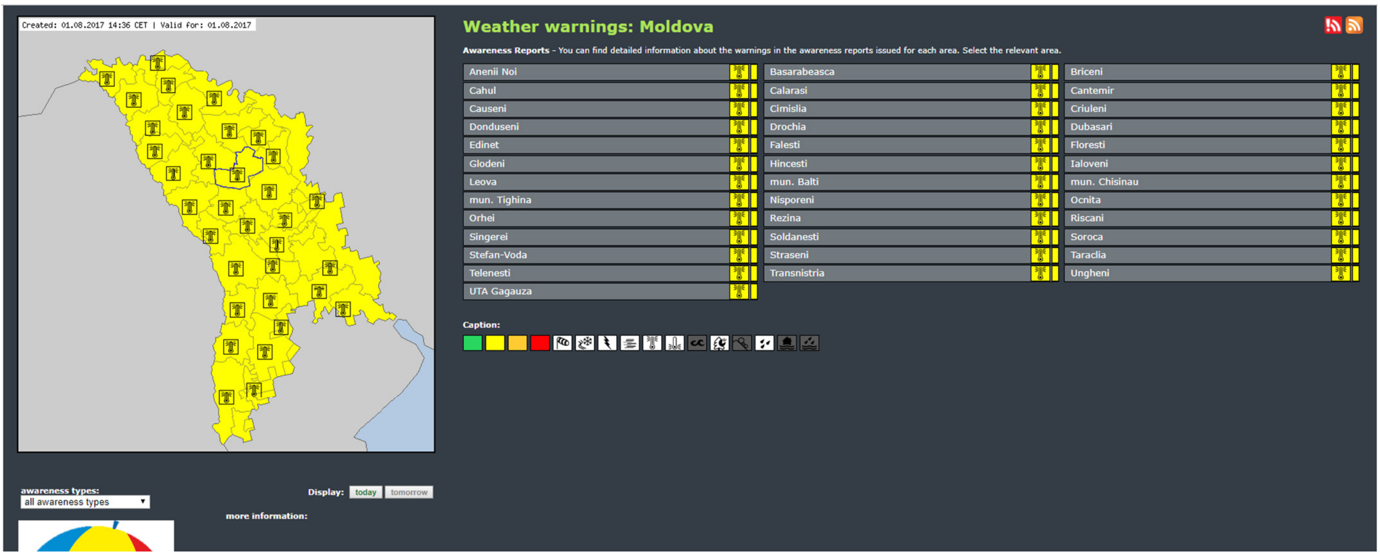


Figure 6-13: Moldova Weather Warning on Meteoalarm System given at the District level <www.meteoalarm.eu>.

In order to improve the quality of data management, availability and access for the general public and specific groups of users, so climatological services would become user-friendly a full reconstruction and modernization of the website of the SHS was necessary. This need was identified during the initial institutional capacity assessment and implemented during 2016-2017.

The modernization of the website of the SHS was done based on three components: design, content and functionality in order to ensure data quality and to improve climate service provision. It included modernisation of the Management System Database of the website as OPEN SOURCE, such as MySQL, integration of SHS with the website http://www.meteoalarm.eu/, upgrading of existing website data flow, importing data from external and internal sources, implementation of automatic stations data visualization graphically, spreadsheets format; presentation of graphics, maps, tables in an interactive way, with automatic loading of databases, creation of modelling options of newsletters, alerts, reports, certificates, extracts from predefined forms, implementing a user management module: create accounts for different user groups: a) individuals b) legal entities (state and private structures, which require specific information);c) civil society, NGOs; d) academics (researchers, scientists, etc.); e) educational environment (teachers, students).

The updated SHSM website was relaunched in November 2017 and can be accessed at www.meteo.md (Fig. 6-14).

Disaster Risk Reduction and Climate Risk Management capacity building. Within the country's framework of Disaster Risk Reduction (DRR) there have already been efforts to integrate it in the national disaster risk management response to climate disasters. The Republic of Moldova is currently developing its capacities to conduct disaster risk assessment. Institutional arrangements for disaster risk management comprise the Republican Commission for Emergency Situations as the main entity responsible for managing emergencies. The Head of the Commission is the Prime Minister; the deputy head is the Director of the DES, which is responsible for disaster prevention, response, relief and recovery. The Commission meets semi-annually and includes representatives from all line ministries and executive branches. District and local emergency commissions have a similar structure and include heads of local governments and relevant public services.

Figure 6-14: The front page of revamped SHS site <www.meteo.md>.

This component was highly supported by the international community through project based assistance. WB Disaster and Climate Risk Management Project (DCRMP) with the objective to strengthen the SHS's ability to forecast severe weather and improve the GoM's capacity to prepare for and respond to natural disasters implemented activities toward strengthened capacities to: (i) monitor weather and issue early warnings of weather-related hazards by providing timely and accurate hydrometeorological forecasts and services; (ii) manage and coordinate responses to natural and man-made disasters; and (iii) help individuals, particularly farmers, be aware of, and adapt to natural hazards and climate variability.

The project provided support to SHS in strengthening severe weather forecasting through developing Early Warning / Nowcasting capabilities. Implementation of Dual Polarization Doppler Radar Technology for Localized Forecasts is now the most effective meteorological tool to predict floods, high winds, hail, and other severe weather, and issue warnings. It improved meteorological modelling systems by providing a mesoscale model and Integrated Meteorological Workstation. Another component of project contributed to development of plans for Seasonal/Climate Forecasts. The Project had some contribution to building a real-time hydrometeorological data system as a first step to improving medium- to long-term forecasting. Improving and automating agrometeorological data collection and distribution improves drought forecasting.

Another component of WB Project contributed to the improvement of disaster preparedness and emergency response - aiming to strengthen the Republic of Moldova's capacity to manage emergencies and coordinate effectively disaster response actions among various levels of government agencies by establishing and operating an Emergency Command Centre (ECC). The project supported the establishment of an ECC for disaster response. The ECC is a state-of-the-art facility with the highest standards of safety, redundancy and accessibility for such facilities. At present, the ECC is equipped with essential IT and mobile communication systems (both hardware and software) for integrating all disaster and preparedness response services in the country, and for providing a unified coordination and command centre.

DCRMP initiated activities for Adaptation to Climate Risks in Agriculture sector aiming to enhance the practical application of agro-meteorological information in the agriculture sector in order to increase its resilience towards adverse weather effects. Under this component, a just-in-time mobile alert system is now operational and provides weather alerts and market information to farmer network. Disaster Loss Data collection is regulated by the current legislation of the Republic of Moldova.

The classification of emergency situations and the methodology for collecting and recording disaster loss data are defined by the Government Regulation No.1076 of 16 November 2010 and the Decree of the Chief of Civil Protection and Emergency Situation Service (CPESS) No.139 of 4 September 2012.

Systematic collection, archive and utilization of data on disasters loss are standardized accordingly to national regulations. Approximation to international standards is envisaged as declared during the "Regional Workshop on Disaster Loss Data" held in the Republic of Moldova in July 2015 within the PPRD East 2 Programme.

UNDP *Disaster and Climate Risk Reduction Project* helped reducing disaster and climate risks in the Republic of Moldova through development of national and local risk management capacities. The project contributed to increased national ownership and leadership for disaster resilience through better coordination capacities, awareness and knowledge and innovative technology transfer. To achieve these, support is provided to the development of the National Disaster Risk Management Strategy and operationalization of the existing coordination mechanism regarded as a platform for mobilization of combined knowledge, prioritization and advocacy on DRR at all levels. In addition, actions are taken to mainstream DRR in school curricula, improve the current extension network in the field, as well as to build up the capacities of mass media to communicate on DRR-related issues. At the local level, innovative disaster risk reduction and climate risk management measures with replication potential were piloted as part of the project's Small Grants Scheme. The Local Level Risk Management Toolkit developed in the initial project phase was expanded to cover regional aspects in risk assessment and mainstreaming. Local level climate risk management measures were piloted at the local level. The tools for local level risk assessment and management developed under this project as well as the lessons learnt from the pilot projects were fed into the project.

DRR capacity building field exercise. Local level prevention capacities for eventual climate risks disasters have been strengthened with a comprehensive civil protection field exercise *„Giurgulesti – 2015"* implemented by the Emergency Situations Coordination Centre of the Commission of the Emergency Situations of the Republic of Moldova and the intervention teams of the Civil and Emergency Situations Service. The exercise was observed by the Head of Civil Protection and Exceptional Situations Service of Moldova, Deputy Minister of Ministry of Internal Affairs, Deputy Minister of Ministry of Environment, representatives of the Austrian Embassy in Moldova, ADA representatives, permanent Deputy Representative of UNDP, attaché of the Austrian Ministry of Internal Affairs in Moldova.

The objective of this training exercise was to test the ability and skills of Moldovan rescue intervention team in the liquidation of consequences of adverse weather conditions in a climate disaster scenario of a long-time and heavy storm accompanied by strong winds and thunderstorm, which brought a sudden raise of Prut river water level and flooded the territory of Giurgiulesti International Port. According to the scenario, long-time heavy rain caused dangerous geological processes with several sever consequences: a locomotive carrying fuel has derailed, causing fire breaks. Fire fighters were organized in several fire-intervention teams, equipped with 24 equipment units and acted according to fire safety procedures. Simulation scenario included also instant road accident involving minibuses and cars with spill in a ditch, with eight people killed, nine injured and another 18 people stricken. The intervention of ambulance and aeromedical crew flying with SMURD helicopter from Romania was done as a response action. During the exercise, Moldovan intervention teams' actions were observed by the international experts from Austria. Austrian evaluators analysed theoretical and practical components of the exercise, and appreciated the high qualification of Moldovan teams and management work of Civil Protection and Emergencies Department administration.

*Transboundary DRR capacity building. The Environmental Protection of International River Basins Project (*ENPI-EPIRB*),* which overall objective is to improve water quality in the trans-boundary river basins of the wider Black Sea region and Belarus and to develop River Basin Management Plans. The Prut river basin has been selected from the Republic of Moldova as trans-boundary test area between the Republic of Moldova and Romania. Project contributed toward improving the legal framework for data and information sharing between administrations at national and international levels. Standard Operating Procedures for the exchange of data on risk exposure, vulnerability, flood alerts and forecasts, need to be established. Timely availability of information and data are essential to promptly react in case of emergency; several international and bi-lateral agreements have been signed by the Republic of Moldova, however the data and information flow needs to be regulated by Standard Operating Procedures.

6.2.4. Climate change adaptation communication and knowledge management

6.2.4.1. Awareness-raising on climate change and relevance of adaptation for sustainable development

Awareness raising and information activities have been carried out as part of capacity building initiatives oriented towards a better understanding of climate change as phenomenon, its multiple impacts and risks, opportunities of adaptation at all levels of governance, including community. In all organised by the CCO events dedicated to the decision factors, technical planners, other stakeholders along with those dedicated to civil society and general public, climate change awareness messages have been not just information delivery events, but have aimed at encouraging stakeholders and citizens of Moldova to take concrete adaptation actions. The needs and purpose of a planned adaptation through setting up of National Adaptation Plan as a process have been clearly stated, explained and discussed with stakeholders, thus increasing their level of knowledge on climate change adaptation, also their interest and commitment in participating in the NAP process. ADA/UNDP Project *Supporting Moldova's National Climate Change Adaptation Planning Process offered* a substantial support in most of the activities referring to the establishment of the NAP process in the Republic of Moldova.

Within the support of ADA/UNDP Project a *Communication Strategy* (CS) and its implementation *Action Plan* was developed with the aim to facilitate inter-sectoral communication in the development of adaptation process; strengthen skills of communication, awareness and promotion of public institutions' adaptation actions; outreach for the general public, as well as donors within the process of elaboration and implementation of adaptation actions. The documents incorporate key messages for general and target groups, available communication tools, channels, activities and events for promoting adaptation planning and implementation. As part of CS, several dissemination, experience sharing and capacity building actions have been implemented at the national and sectoral levels. These actions were oriented towards facilitating the inter-sectoral connections in the development of national adaptation planning process; strengthen skills of communication, awareness and promotion of public institutions' adaptation actions, outreach for the general public within the process of elaboration and implementation of adaptation actions.

In formal education of Republic of Moldova climate change adaptation is addressed as part of environmental education in general schools, while higher education institutions such as Technical University of Moldova, State University of Moldova, State Agrarian University of Moldova, other institutions have included it as a stand-alone subject or across disciplines in BCs and MSc curricula. Based on good collaboration between the Civil Protection and Emergency Situations Service (CPESS) and undergraduate students, the latter have requested, through DRR clubs and debate courses more practical DRR lessons. This request has been up-taken by the Government which has, with the promulgation of the "Educational Code of 2014", promoted the intensification of practical teaching and training in the area of DRR.

A specific public awareness and participation strategy with regard to disaster prevention doesn't exist at the moment, however, the Civil Protection and Emergency Situations Service has produced a draft of *Strategy for Communication and Prevention of Emergency Situations*, which is expected to be approved. The Strategy will cover main population groups - pre- and schoolchildren, youth, elderly and disabled people, civil protection volunteers and civil protection professionals.

The Ministry of Communication and Technology, working within the framework of the Law on Communication, is ensuring direct communication amidst institutional stakeholders at state level. A e-cloud system has been implemented in order to facilitate sharing of data and is currently running.

Organizing climate change adaptation thematic events was seen as an efficient way that stimulates discussion and exchange of knowledge among different target groups, raises adaptation awareness, share experience, disseminates results and liaises with stakeholders (Fig. 6-15). A public debate on the topic *"Challenges and opportunities of climate change"* aiming to familiarize the young people with climate change as a phenomenon, its impact on people's everyday lives, including gender-specifics in the context of climate change was organised. The main objective of the debate was to increase the awareness of citizens regarding climate change in Moldova and develop young people's interest in promoting priority adaptation actions as a response to these changes. The event brought together experts in the field of climate change adaptation, gender equality, students, media and NGO representatives. The debate had a live on-line and radio broadcasting.

Within two-day thematic training seminar *Strategic communication in promoting of development projects in the Republic of Moldova,* State Chancellery representatives and 45 sectorial level communicators of 16 Ministries of the Republic of Moldova have been informed and trained in climate change communication areas, links between adaptation and Moldova's Sustainable Development Goals (SDGs), tools in monitoring climate media materials, significance of climate messages given through visualization.

Local level workshops with title "*Climate change adaptation awareness raising and capacity building initiatives"* were held in most vulnerable from climate change point of view districts in three Development Regions of Moldova: North – Singerei, Falesti; Central – Calarasi, Nisporeni; South – Basarabeasca, Leova. The workshops were attended by the decision factors of region and district levels, community leaders, local industry leaders, farmers, private sector and NGOs representatives (Fig. 6-16).

Figure 6-15: Awareness razing and information events organised for target audience and general public.

Figure 6-16: Awareness razing and information events organised for district and community level target audience.

The events aimed at understanding climate change as phenomenon and the main causes of the global climate change, as well as the likely impacts on the Republic of Moldova; understand the threats climate change poses to districts, communities and livelihoods and the importance of climate change consideration at the local level; learn about tools to assess local vulnerabilities with respect to climate risks; facilitate thinking about ways to promote and implement climate change adaptation measures at the local level; understand the opportunities offered through implementation of innovative climate change adaptation technologies and measures. The events were coupled with ADA/UNDP Grant Scheme promotion with the goal to implement priority innovative adaptation measures based on pilot projects in the communities vulnerable to climate variability and change.

Climate Change Office representatives, Ministry of Environment and line ministries decision factors, representa-tives of district and community levels councils, national experts, grant beneficiaries, along with civil-society representatives have participated in a number of public events, conferences, seminars, radio and television discussions on climate change adaptation planning and implementation. Awareness-raising activities have been organized both by individual government entities as well as jointly with UNDP, NGOs, youth groups, the private sector and the media.

6.2.4.2. Climate change adaptation knowledge management

Climate change brings a new dimension to development work, it is loaded with science and requires fresh self-reflections, new investigations and careful observation of cause and effect relationships to bring about new ways of adapting to its effects. Responding to climate change is a knowledge-intensive undertaking, and access to relevant and usable knowledge is an important prerequisite for successful and cost-effective adaptation actions. Management of this information and knowledge is important for enhancing institutional capacity whether it is individual organizations, inter-agency processes or team approaches; and is essential for fostering and maintaining participation and partnerships.

In the Republic of Moldova, information and knowledge on climate change issues continue to be generated from the scientific studies, assessments and other tools. Lead agencies and relevant national institutions have an important role in spreading information and knowledge about climate change to national stakeholders, institutional learning being an important component of effective adaptation. Government institutions, NGOs and the private sector organizations also started preparing to adapt in both their mandates and ways of doing business.

The *Institutional Capacity Assessment* revealed several limitations and other challenges facing Moldova's CCA-related knowledge management efforts. Many of these limitations have their genesis in the deluge of new data, information, and knowledge continually generated on climate change issues from scientific studies, assessments, and other tools and being not well managed. These knowledge products are produced by a disparate array of institutions, including government, NGOs, academia, private sector organisations, etc. many of which do not have in situ arrangements for capture, documentation, and dissemination. To date there is limited progress in the country with respect to strengthening capacity for knowledge management and dissemination of climate related information. Climate change and related information is stored in various locations and is not easily accessible by the public. There is also an absence of mechanisms that ensure that scientific and other valuable climate and environmental information is shared across government and civil society sectors. The absence of any policy or strategy on climate related knowledge management further hampers capacity development in this area.

According to ICA, the main systemic level impediments to enhance climate related knowledge management include:

- limited understanding and knowledge within government and lead agencies on knowledge management;
- absence of guiding policies and/or strategies on knowledge management;
- limited capacity (personnel, equipment, operational budgets) to promote and enhance knowledge management in lead organizations;
- limited networking of government and other agencies to promote and enhance knowledge management; and
- lack of commitment by governments and policy for information management that promotes government-wide information sharing.

Knowledge management framework. The absence of any policy or strategy on climate-/CCA-related knowledge management further hampers capacity development in this area, therefore, *a Knowledge Management Strategy (KMSy) and a Climate Change Knowledge Management Plan (KMP)* with the aim to leverage existing knowledge resources on climate change adaptation, enhance adaptation's visibility for both domestic and international audience was developed. The main users of developed KMSy and KMP is the staff of Climate Change Office (CCO), Ministry of Agriculture, Regional Development and Environment, line ministries, climate change experts, policy makers, a wide range of CCA technology practitioners, NGOs, other stakeholders involved in climate change adaptation. According to the KMSy, Climate Change Office will work to establish continuous sharing of CCA progress and open reflection on ongoing activities as a key principle of its business, in thematic policy work and advisory services as well as operational and administrative work. Sharing knowledge in person as well as online, should be promoted, incentivized, supported with appropriate tools and rewarded as default mode of doing business, with senior management staff leading the way. It is also foreseen that KM considerations will be included in each sector's policy strategy to ensure cohesion and to ensure the integration of KM into own policies within the different ministries. Useful knowledge management will be characterised by practical examples, targeted to the intended audience. KMSy seeks to enhance the engagement with the private sector by building relationships, partnerships and new alliances and coalitions at country, regional and global levels.

Structure of knowledge resources platform. For specific platforms dedicated to online dissemination of the desired adaptation content and project-specific content, the following websites are used at the national level: www.adapt.clima.md and www.clima.md, www.mediu.gov.md, www.comunicare.md Climate Change Office becomes the physical repository for available knowledge products on climate change adaptation at the national level. Its efforts in managing and disseminating this information are oriented toward enhancing the knowledge on climate adaptation, to communicate the significance and meaning of CCA action, to educate, and to raise awareness. A number of approaches are employed: documents management, learning/teaching management, search engine optimization, links to social media, and CCA interpretation. The applied approach captures the impacts of CCA work, showcase results achieved to date, as well as harvest additional knowledge that is captured by the various implemented projects.

On UNDP's knowledge-sharing platform: *www.adaptation-undp.org*, a dedicated NAP project profile for Moldova was created. Highlighting ADA/UNDP Project's CCA work on this platform is therefore a vital link between otherwise isolated national products.

Another international platform that was used is *www.weadapt.org*. WeAdapt as a multimedia, cross-agency knowledge management platform focussed on CCA allows practitioners, researchers and policy-makers to access credible, high-quality information and connect with one another.

Using national and international platforms, CCO endeavours to assemble knowledge resources which match their style and thematic areas, with a particular emphasis on sharing challenges and solutions in the 'enabling environment' domain, especially CCA mainstreaming within the sectoral policy framework, and sector-specific CCA strategies and action plans, lessons learnt at the local level, gender-specific initiatives, etc.

The *Climate Change Adaptation Information System* (*www.adapt.clima.md*) on monitoring, reporting and evaluation of adaptation planning and action which is under development is seen as a web-based portal on CCA information and knowledge management, also as a tool to collect and stock adaptation-related information at the national and sub-national levels with special focus on sector level, and a modality of knowledge sharing with regard to advances in adaptation implementation, reporting and evaluation. Over time, the growing database of measured engagements can serve to provide an unparalleled research base for Moldova.

Outreach activities. When there is clear responsibility for KM efforts on CCA, this increased knowledge sharing will enhance the legitimacy and practicality of CCA efforts in Moldova and will simultaneously reinforce the capacity of the ministries, and increase donor confidence.

Republic of Moldova seeks to enhance its engagement with the private sector by building relationships, partnerships and new alliances and coalitions at country, regional and global levels. For example, ADA/UNDP project Communication and Outreach Strategy was a guiding document in implementing communication and outreach activities oriented toward communicating adaptation and facilitating the inter-sectoral communication in the NAP elaboration process; strengthen skills of communication, awareness and promotion of public institutions' adaptation actions; outreach for the general public, as well as donor within the process of elaboration and implementation of adaptation actions. Effective and systemic implementation of technical assistance on communications and outreach strategies and CCA activity results, as well as efficient organization and coordination of the communications process, contributes to enhance Moldova's internal capacity and broader success in delivering projects with stronger and measurable impact.

KM as part of M&E. Communicating climate knowledge and disseminate the information related to adaptation planning and implementation is a component of M&E framework. Knowledge and communications products will be monitored and evaluated as well, along with other CCA components. Through implementing information and knowledge management effective reporting on how knowledge and communications products are disseminated requires reliable information on whether they achieve their intended results.

Using social media as an active dissemination tool for the planned knowledge products will allow the management team to highlight the results of the individual activities/projects to different audiences and mobilise partners, stakeholders, and the general public to advocate for the results achieved through the portfolio.

To help establish a scalable social model that can effectively reach the broadest audience, CCO has established various presences on Facebook, YouTube, Twitter, and Flickr. These channels are easily consumed via smart phones enabling mobile access for a large part of the country's population, therefore will be used further in awareness raising and dissemination activities. Key performance indicators (KPI) will be determined at a high level on a weekly basis by evaluating the week-over-week change of total interactions, fans, number of active fans of Facebook pages.

In measuring Twitter performance using KPI will help identify mentions, followers and reach. Tweettronics (www.tweettronics.com) will be used as way to view and monitor overall Twitter mention volume, reach, number of speakers and most common key words associated with specific brand in the Twittersphere.

Web Analytics is used to get info on webpages visits. This tool was used by adaptation projects teams to monitor the number of webpages visitors. Google Analytics was part of sectoral communicators' training on climate change adaptation communication.

6.2.4.3. Enhancing institutional capacities of line ministries and relevant agencies with respect to climate change adaptation

Strengthening of institutions at national, sector and district levels to plan for and implement adaptation was a continuous effort during the reporting period as there was a need to generate enough interest from decision-makers to demand and be receptive to climate vulnerability information.

Institutional capacity for climate change adaptation planning of line ministries and agencies of the Republic of Moldova was enhanced via a number of modalities:

- capacity needs assessment workshop, roundtables and meetings were held for key sectoral stakeholders with special focus on Ministry level decision makers and technical planners. During these events reports and presentations addressing sectoral gaps with regards to climate change adaptation were presented and solutions discussed.
- the conference entitled *Environment and climate change: from vision to action* had the objective to promote the importance of establishing medium- to long-term planning for adaptation at national and sub-national levels, targeting national and sub-national policy-makers and other stakeholders. The participants discussed sector adaptation needs identified during ICA and the modality of integrating sectors into NAP process.
- dedicated events were organised in order to strengthen the leadership within key Ministries by targeting national and sub-national policy-makers and other stakeholders, on the importance of medium- to long-term planning for adaptation. Meetings with all relevant partner institutions (Ministry of Health, Ministry of Transport and Road Infrastructure, Ministry of Environment, Ministry of Regional Development and Construction, Ministry of Agriculture and Food Processing Industry, Civil Protection and Emergency Service) from the priority adaptation sectors were organised in order to discuss their visions on implementing NAP process in Moldova, approaches to be used, national and sectoral mandate. The roundtable *"Enhance the national vision and mandate for the NAP process"* had the objective to increase knowledge of stakeholders on NAP process, present mandate and vision of national adaptation planning process, the need of comprehensively and iteratively assessing development needs and climate vulnerabilities, and institutional functions in adaptation.

A number of short-term trainings were conducted for sectoral planners in the use of the tools and approaches to advance medium- to long-term adaptation planning, budgeting and implementation, each training being supported with guiding materials produced for both participants' use and for wider dissemination.

The training seminar on *screening policy documents against climate risks and opportunities and mainstreaming climate change adaptation into sectorial planning* was organized for technical planners of key ministries from the Republic of Moldova: Agency for Land Relations and Cadastre, Ministry of Environment, Ministry of Agriculture and Food Processing Industry, Ministry of Regional Development, Ministry of Foreign Affairs, State Chancellery, Ministry of Finances, Ministry of Health, Moldsilva Agency, Tourism Agency. The methodology helped to raise awareness of the need to mainstream climate change into national development planning, generate support and buy-in for a sectoral and where possible, cross-sectoral approach to climate change adaptation mainstreaming, and improve coordination by involving a wider group of stakeholders. Training topics covered: (i) introduction to climate change and fundamentals; (ii) tools and methodologies; (iii) sectoral case studies; (iv) group exercise in applying methodology; (v) group exercise in prioritization and needs assessment; (vi) assessing needs and recommendations for moving forward. As a result of the training, the national institutions´ representatives reinforced their understanding of Moldova´s climate profile and scenarios, key concepts on climate change and development processes, use the methodology for assessing climate risks and opportunities, and integration of climate risks in sectoral plans, strategies and planning processes. During the training participants shared information and experiences in the identification of needs in order to achieve a more significant integration of climate change in the country´s planning processes. Discussions were held among participants on the assessment of climate risks and opportunities in key sectors, with active participation in practical exercises about real strategy documents.

Applying climate change adaptation mainstreaming approach in national and sectoral planning training was given to technical planners of the State Chancellery, chefs of Departments of Policy Analysis, Monitoring and Evaluation of Line Ministries. With a focus on the importance of climate change mainstreaming into planning process at the national level, the event aimed to promote among high-level segment of governance the need to consider CCA mainstreaming into national policies and discuss methodological approaches derived from case studies and activities already implemented, to foster the exchange of information and opinions among participants, good practice, ideas, experiences and successes acquired in executing implementation of adaptation measures, also provided an opportunity for participants to explore possibilities for cooperation among sectors. The training followed the key principles underpinning the *"UNDP Quality Standards for the integration of adaptation to climate change into development programming"*[195] methodology for identifying climate risks, risks of maladaptation, opportunities for adaptation and specific adaptation measures are: (i)identification of climate change risks to strategies, policies or plan, (ii) identification of risks that may result in maladaptation, (iii) identification of adaptation opportunities, (iv) assessment and Integration of potential adaptation measures. The training was designed for State Chancellery staff, Chiefs of Departments of key Ministries from the Republic of Moldova: Ministry of Environment, Ministry of Agriculture and Food Processing Industry, Ministry of Regional Development, Ministry of Foreign Affairs, State Chancellery, Ministry of Finances, Ministry of Health, *Moldsilva* Agency, Ministry of Transport, Tourism Agency, Agency of Land Planning and Cadastre, Civil Protection department, Ministry of Economy.

District level capacities are an important element of local capacities with regard to implementation of climate change adaptation at the local level. Development of such capacities remains a challenge for Moldova, where resources for development and implementation of adaptation actions at this level are limited. While efforts put and progress has been made on integrating climate adaptation into decision-making at sector level, many challenges remain with this regard to local level, in particular rural communities, while at this level there are most of vulnerable groups. Therefore, project based support was provided to Local Public Authorities (LPAs) of 6 districts, bringing them up to the level of performance or engagement as partners appropriate for their roles in implementing CCA measures at the ground level. Information and training seminar on *screening policy documents against climate risks and opportunities and mainstreaming climate change adaptation into district level planning process* was organised for LPA representatives. This activity was important to implement, as a modality of embedding new knowledge and understanding into existing LPAs structures, expands and strengthens them and contributes to the adaptation ownership. The training was tailored to the specific needs of district communities and helped strengthening the capacity of LPAs to implement adaptation interventions in priority sectors. It also encouraged the transfer of local knowledge, for example through a local network to exchange with neighbour districts. Participants noted that further efforts should continue to be developed and strengthened knowledge and skills of decision factors of district level to incorporate CCA into district level strategic planning and development policy.

Several thematic area trainings have been conducted within ADA/UNDP Project for the chief engineers and technical staff from the State forest enterprises subordinate to *Moldsilva* Agency. The training was attended also by the administrative staff of Moldsilva Agency and Forest Research and Management Institute of Moldova Institute (ICAS). The topics covered general description of predicted climate change and its impact on forest ecosystems of Moldova, along with forestry practices to improve forest resilience and to adapt to climate change. Participants benefited from detailed analysis and presentations of adaptation measures in response to current and future vulnerabilities of local forest sector to climate change. During participatory training there were discussed measures designed to increase the resilience of the forest sector in a holistic approach contributing to tackle the impact of and adaptation to-climate change.

WHO/Europe Office and WHO Country Office supported health sector of the Republic of Moldova to strengthen its capacity to cope with the new challenges posed by climate change. Priorities for joint work are set out in the biennial collaborative agreements (BCA) between WHO/Europe and the Republic of Moldova. WHO/Europe Regional and WHO MD office in collaboration with ADA/UNDP Project have organised 3 day technical capacity building training for health professionals, heads of district level public health units on thematic areas of climate impact on human health and sector level response which is fundamental to taking protective actions against climate related health risk, to better understand and prevent negative impacts of climate change on health. The course covered the basics of climate change, its effects on health, and appropriate tools and actions to reduce climate related health risks. The training was complemented by the stakeholder workshop on scoping the health sector adaptation strategy and action plan. The workshop contributed to technical capacity building and knowledge-sharing through improvement in planning and implementation of climate change adaptation.

Promoting the development and dissemination of tools and methods for adaptation planning and implementation. A key component in addressing institutional capacity adaptation efforts successfully is the availability of appropriate, context specific tools and instruments to apply mainstreaming approach, in particular methodological materials and guidelines. Therefore, a number of guiding materials have been adopted from the international sources[196] and adjusted to country specific needs or developed namely for adaptation cases of the Republic of Moldova and lately disseminated regionally and internationally.

Mainstreaming Climate Change Adaptation into Moldova´s Policy and Planning Guide was developed as a policy instrument for mainstreaming CCA into sectoral strategies and their action plans. This methodological tool provides an analytical approach and structure of mainstreaming procedure, highlighting the importance of active engagement of stakeholders and following a stepwise approach in incorporating adaptation into already existing sectorial development planning of the Republic of Moldova.

[195] UNDP (2011). Mainstreaming Climate Change in National Development Processes and UN Country Programming: A guide to assist UN Country Teams in integrating climate change risks and opportunities. UNDP: New York, NY, USA

[196] Least Developed Countries Expert Group. 2012. *National Adaptation Plans. Technical guidelines for the national adaptation plan process*. Bonn: UNFCCC secretariat. Bonn, Germany. December 2012.

Mainstreaming climate change adaptation into the sectoral planning of transport and energy sectors prove to be challenging, due to the sector-specific context of that time, from which insufficient knowledge on CCA at the sector level and, in particular, modalities to mainstream adaptation into planning was the most evident one. Therefore, ADA/UNDP Project has supported the development and publication of methodologically oriented brochure". *Climate change adaptation measures proposed for energy and transport sectors to be incorporated into sectoral policies"*[197].

Another aspect that needed more elaboration, was the econometrics of proposed adaptation measures for sectoral planning, therefore, a dedicated publication on application of cost/benefit analysis of proposed adaptation measures based on the concrete example of transport, agriculture and energy sectors was developed by the national consultant *"Cost-benefit analysis in assessing sectoral measures to adapt to climate change"*[198].

A knowledge supporting material was the *Glossary of climate change adaptation terminology*[199] adopting mostly IPCC terminology, a publication developed as at the request of sectoral communicators, journalists, sectoral planners but also for all users interested in CCA and willing to understand and use correctly the terminology in order to avoid misinterpretation.

Implementation of adaptation practices referring to conservation agriculture in combination with correct crop rotation by local farmers along with installation of PV system in remote communities of Moldova required day- to -day guidance and tutorial work from the national adaptation experts in the area. As guiding material the brochure *Conservation agriculture*[200] was developed

A user's *Methodological Guidelines on climate tagging of the national public budget*[201] is a support document for mainstreaming CCA into the national budget. These guidelines articulate the process for identifying ('tagging') climate change expenditures across sectoral budgets, for the use of officials and technical staff as part of the sectoral budget development process. The described in the Guide approach supports the ability of the Ministry of Finance and the Ministry of Environment of Moldova to track climate expenditures and improves their ability to ensure progress on climate change vis-à-vis Moldova's national development goals and international commitment. This process also supports the development of the financial records required to help build a climate-financing framework.

A number of adaptation oriented guiding materials have been developed in support to the implementation of ADA/UNDP Project Small Grants Scheme: *Guidance for implementing climate change adaptation options*[202] grant scheme specifying the principles of districts' selection for implementation of adaptation interventions, sectors' prioritization at the local level and the general approach for financing CCA interventions locally. It contains general requirements of application process, selection process and eligibility criteria for adaptation project proposals, project partners and project cost. The Grant Scheme was promoted in six most vulnerable districts from three regions of Moldova (North, Centre and South), the selection being based on the *Existence Vulnerability Index (EVI)*, developed in the Republic of Moldova's Third National Communication submitted to the UNFCCC (2014). Information materials in a leaflet format were developed for better informing of community level applicants on innovative technologies to be implemented for enhancing household and community level climate resilience and adaptation. Distribution of the information material was accompanied by awareness raising and information campaign

Experience sharing events. Identifying and collecting good practices, challenges, experiences and lessons learnt from all types of adaptation works was an ongoing process during the adaptation planning and implementation in the Republic of Moldova and disseminated through media and internet platforms. Experience sharing workshops proved to be an efficient modality in promoting adaptation priorities at the local level and ensure their ownership at community level.

Many farmers in the districts are increasingly recognizing that modern economically profitable agricultural practices are vital in the current climate environment of Moldova, therefore, sharing gained experience and disseminate pilot projects results was an important activity undertaken by the grants beneficiaries.

Local farmers, community level authorities, local NGOs in collaboration with CCO have organized a number of experience sharing workshops referring to the conservation agriculture technologies in support to climate smart agriculture and water management at the community level through construction of small-scale water catchments for crop irrigation. The main objectives of each workshop was to promote among participants innovative approaches and technologies as a way to adapt to climate change, share the experience gained during the implementation of pilot projects, engage local authorities and farmers in similar adaptation initiatives through scaling up of pilot projects experience and also to contribute to capacity-building of local communities with regard to climate resilience (Fig. 6-17, Fig.6-18).

Figure 6-17: Community Level Sharing Experience events in Implementing Smart Farming Technology.

[197] Aparatu S. & Dragoman S. (2016) Măsurile de adaptare la schimbarile climatice propuse sectoarelor energie și transport spre a fi incorporate în politicile sectoriale. OSC, ADA/ UNDP: Chișinău, 44p.
[198] Baltag G. (2016) Aplicarea metodei de analiză cost-beneficiu în evaluarea măsurilor sectoriale de adaptare la schimbările climatice. OSC, ADA/ UNDP: Chișinău 64 p.
[199] Rudi T. & Druță A. (2016) Glosar de termini privind adaptarea la schimbarile climatice. OSC, ADA/ UNDP: Chișinău 44 p.
[200] Batiru G. (2015) Agricultura conservativă. Măsuri de adaptare la schimbările cliamtice în agricultură. OSC, ADA/ UNDP: Chișinău 20 p.
[201] Yovel E. (2016) Methodological Guidelines on climate tagging of the national public budget, OSC, ADA/ UNDP: Chișinău, 54 p.
[202] Ghidul operational al solicitantului. <http://www.adapt.clima.md/public/files/Ghidul_solicitantului.pdf>

The dissemination of successful practices and the approaches demonstrated during the course of the pilot projects implementation was done both by national experts and by grants beneficiaries, in this activity they played a central role in highlighting opportunities to replicate successful pilots and create self-sustaining results, in particular for agriculture and water sectors. Open discussions on various climate and technology related topics of interest for workshop participants were held, along with on-site demonstration of technology operation and guidance with regard to application of a specific technique (Fig 6-17, 6-18).

At the local level, of particular importance were information and experience sharing workshops on promoting renewable energy technologies as a modality to adapt co climate variability and change. The main objective of each workshop was to promote among participants innovative approaches and technologies in the energy sector, in particular PV systems, as a way to adapt to climate change, share the experience gained during the implementation of energy pilot projects, engage local authorities and civil society in similar adaptation initiatives and also to contribute to the capacity-building of local communities with regard to climate resilience.

Figure 6-18: Experience Sharing Events on Promoting Conservation and Precise Agriculture at the Community level.

The workshops combined different activities such as awareness raising and information on climate change phenomenon and the need to adapt to these changes. The dissemination of successful practices and of the results achieved by the demo projects was done by the grants beneficiaries who played a central role in highlighting opportunities for replication of successful pilots and creation of self-sustaining results, in particular for energy sector. Open discussions on various climate and technology related topics of interest for workshop participants were held along with on-site demonstration of technology operation and guidance on their application.

6.2.4.4. Social media and platforms promoting adaptation to climate change

The availability of the information to decision makers and general public is an important aspect in awareness raising, capacity building and knowledge development. Online dissemination of resources is intended to contribute to highlighting the importance of climate resilient development, improved communication between sectors and between different levels of the local public administrations and the government, and facilitation of multi-stakeholder engagement in producing expected adaptation planning outputs.

Using social media as an active dissemination tool for the planned knowledge products allows CCO, adaptation projects teams to highlight the results of individual activities to different audiences and mobilize partners, stakeholders, and the general public to advocate for the results achieved through the project portfolio.

For example, "*Cultivating Climate-Resilience in Moldova*" success story was featured on multiple platforms *www.adaptation-undp.org*; *www.undp.org*; *www.md.undp.org*; *http://adapt.clima.md/*. The information was also placed on the Facebook page: *https://www.facebook.com/adaptarea-la-schimbarile-climatice*.

Increased use of online tools for awareness-raising activities, such as websites, social media has been applied in awareness-raising, information and dissemination events. The information on awareness–raising, experience sharing workshops and other events was promoted and disseminated via social media means Facebook, Instagram, Tweeter, Youtube, Flickr.

Dedicated www.adapt.clima.md, www.clima.md and Facebook page "#adaptarea la schimbarile climatice", were used to increase the visibility of adaptation related events, actions, projects to the general public and also as a way of sharing knowledge and information to support the needs of stakeholders such as decision makers. The website e-library, along with publications posted on Issuu website contain developed methodological guidance dedicated to vulnerability and adaptation issues and modalities to address them.

To increase the availability of information to targeted audience, specifically at local level, the posting of information referring to the progress, achievements and lessons learnt of implemented pilot projects was complemented by the Regional Development Agencies webpages http://www.adrsud.md/, Central http://www.adrcentru.md/ and South http://adrnord.md/, local radio and local newspapers.

A visibility campaign that showcase the results of implemented adaptation pilot projects, along with the achievements of SHSM-ZAMG partnership have been promoted through a *portfolio of success stories* complemented *by the photo essays* visually highlighting the work done. The information was posted on the country and global UNDP platforms:

Photo essays
Improving meteorological services in Moldova;
Smart farming technologies;
Through rain or shine.

Success stories:
Cultivating climate resilience in Moldova;
Restored reservoirs allow business to bloom in rural Moldova;
Women leading the way to climate-resilience in Moldova;
Lighting the way for climate-resilient energy in Moldova.

promoted through www.weadapt.org, www.adaptation.undp.org, www.undp.org, www.md.undp.org, www.one.un.org, www.adapt.clima.md (Fig. 6-19)

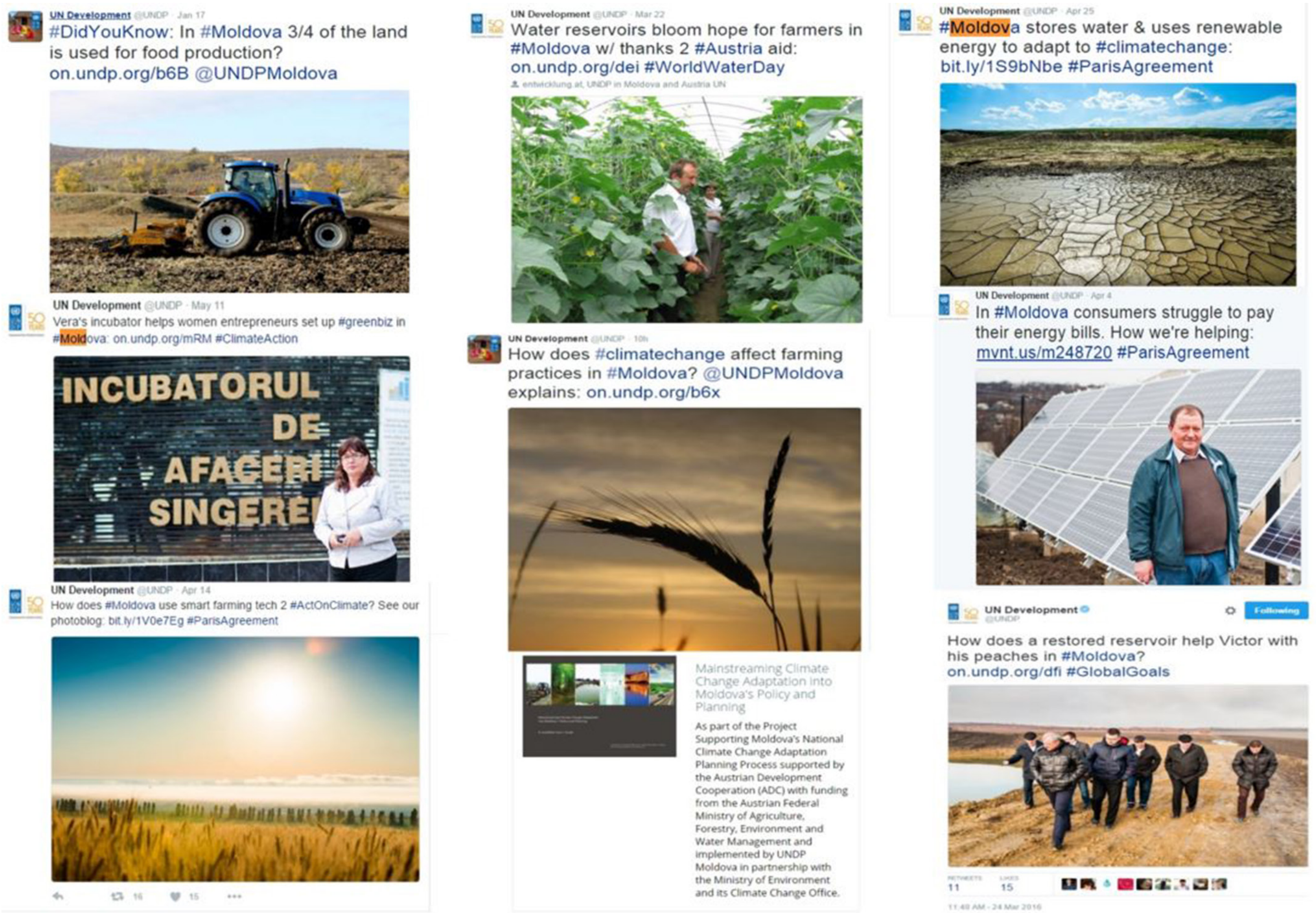


Figure 6-19: Communicating Climate Change Adaptation Experience through Success Stories of Pilot Projects.

Moldova Flickr *Photobook* have been collated and contains information on the specifics of climate change impacts on Moldova's economy sectors and population and the ongoing activities of adaptation planning at the national and subnational levels. These activities emphasize stakeholder engagement and capacity building, institutional arrangements, created enabling environment for adaptation action, including mainstreaming adaptation into planning processes.

Video and radio spots versions (Fig. 6-20) have been produced with the goal to raise awareness among local population, promote the ADA/UNDP Project results and increase NAP process visibility, they can be accessed at https://youtu.be/Oz1tCPPACFo, (short version): https://youtu.be/ypZR-TWdNnY radiospot: https://youtu.be/BpbEv5CDxf4.

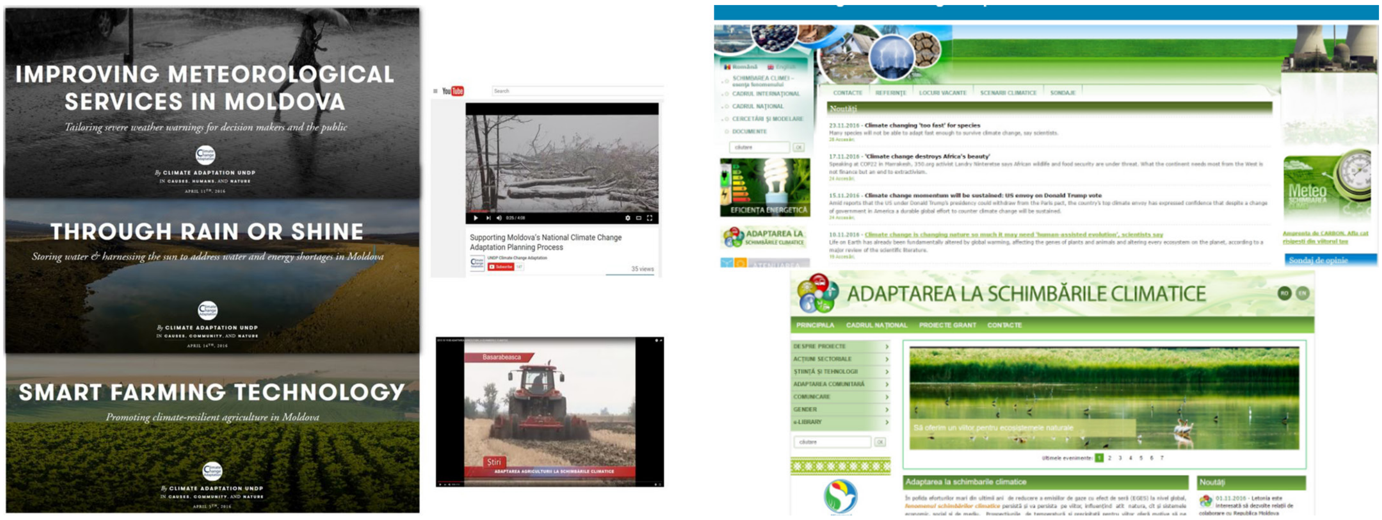


Figure 6-20: Using Multiple Platforms to Promote Adaptation Knowledge and Inform Wide Audience on Climate Change Practices, Pilot Projects Results, Implementation Adaptation Experience.

A sound event was field exercise *„Giurgulesti–2015"* implemented by the Emergency Situations Coordination Centre of the Commission of the Emergency Situations of the Republic of Moldova and the intervention teams of the Civil and Emergency Situations Service within the framework of the Agreement on Support signed between the Republic of Moldova and the Federal Government of Austria regarding the mutual assistance in case of natural and technological disasters and the cooperation for their prevention (Fig. 6-21).

Figure 6-21: Civil protection field exercise "***Giurgulesti–2015***" implemented by the Emergency Situations Coordination Centre of the Commission of the Emergency Situations of the Republic of Moldova and the intervention teams of the Civil and Emergency Situations Service.

In collaboration with the press service of the Civil Protection and Emergencies of the Ministry of Internal Affairs, the information was distributed through the network of 100 e-mail users comprising representatives of national and regional media outlets, including blog sites holders. This approach was enforced by the announcements through direct calls to reporters of media Companies institutions: *Prime TV, PRO TV, Publika TV, TV 7, Channel 3 Moldova 1*. During the event a video gallery was created and video images were recorded; they were later distributed to civil society through social networks.

After completing the exercise, communication experts issued press releases that was posted on various websites and through a number of media channels (*Dse.md, Jurnaltv.md, Moldova-suverana.md, Provincial.md, Trm.md, Jurnal.md, Dsecahul.blogspot.com, Canal3.md, Prime.md, Protv.md, Monitoruldegalati.ro, Adevarul.ro, Viata-libera.ro, 24news.md, Youtube.com, Facebook*) based on a text with positive connotation, strictly informational.

Within its agriculture component, World Bank has financed 53 sub-projects for piloting integrated agricultural and agronomic technologies for adaptation to climate risks, and disseminated the experience and lessons-learned to around 2840 farmers (of which 27% women) in more than 70 dedicated field-day events. In collaboration with the press service of the Civil Protection and Emergencies of the Ministry of Internal Affairs, the information was distributed to about 100 e-mail addresses of representatives of national and regional media outlets, including blog sites holders. This approach was enforced by the announcements through direct calls to reporters of media Companies institutions: *Prime TV, PRO TV, Publika TV, TV 7, Channel 3, Moldova 1, Europa Libera*. During the event a video gallery was created and video images were recorded, which were later distributed to civil society through social networks.

International cooperation on climate change education, awareness raising and the development of low-carbon development strategies and plans has been essential in advancing with climate change adaptation. Being in advanced phase of its implementation, ADA/UNDP adaptation Project produced tangible results and made progress in adaptation at the country and regional levels. Therefore, a co-organized with UNDP-UNEP National Adaptation Plan Global Support Programme (NAP-GSP) and in collaboration with the Government of the Republic of Moldova and UNDP Regional Hub for Europe and CIS, the regional workshop *"Supporting countries to advance their National Adaptation Plan (NAP) process"* presenting Moldovan experience as a showcase in the area of adaptation, was organized 28-30 June, 2016 in Chisinau. The event allowed delegates from 16 countries to share their national experience on identifying medium- and long-term climate adaptation needs and to mainstream these needs into national development planning processes and strategies (Fig. 6-22). The press release of 19.07.2016 mentioned that *„Since 2013 the Government of Moldova with UNDP has been implementing the project "Supporting Moldova's National Climate Change Adaptation Planning Process"* funded by the Government of Austria through the Austrian Development Agency. The project has supported institutional and policy frameworks and capacities for medium to long-term gender-sensitive adaptation planning in Moldova and piloted adaptation interventions in priority sectors. Through a comprehensive participatory consultative process, the project delivered a draft national inter-agency coordination mechanism/national adaptation framework, along with a monitoring and evaluation framework; sectoral NAPs for forestry and health sectors; recommendations for mainstreaming adaptation into the transport and energy sectoral plans; and a number of guidelines and tools to support the NAP process". During the event participants shared information and experiences in the identification of needs in order to achieve a more significant integration of climate change in country´s planning processes.

During annually held by the Ministry of Environment and international organizations events *Europe Day, World Environment Day, Moldova environmental day, EU Sustainable Energy Week* national experts on adaptation, CCO, PIUs of adaptation related projects used the events to raise awareness among local population and promote adaptation action through speeches, discussions, debates, posters, brochures, leaflets, video spots .

Figure 6-22: Eastern Europe, Caucasus and Central Asia Regional Training Workshop Supporting countries to advance their National Adaptation Plan (NAP) Process from the National Adaptation Plan Global Support Programme (NAP-GSP), 28-30 June 2016, Chisinau, Republic of Moldova.

6.3. Approaches to mainstream climate change adaptation into sectoral planning of the Republic of Moldova

Sectoral government plays an indispensable role in facilitating the integration of adaptation into planning and implementation of development policies therefore, based on undertaken Institutional Capacity Assessment of key sectors of the Republic of Moldova, identified needs and proposed actions of Capacity Development Plan, mainstreaming of Climate Change Adaptation into sector development planning was seen as an immediate need. Adaptation mainstreaming into sector level planning of Moldova was the effort of incorporating priority responses to climate change in strategies, policies and their implementation action plans in order to reduce potential climate risks and vulnerabilities. Republic of Moldova has approached adaptation mainstreaming from a climate change perspective both through development of climate change specific policy documents and associated implementation action plan, that address developmental aspects of vulnerability, and also from a development perspective, integrating climate risk into sectoral development policies and action plans. In doing this Moldova is striving to get away from discreet, stand-alone adaptation actions addressing climate risks and adopt an integrated sectoral response incorporating adaptation into national and sectoral development to the extent possible.

Redesigning the development framework of economy sector in the Republic of Moldova through incorporation of adaptation into strategic documents proved to be a complex and challenging process, requiring advanced level of expertise on climate change vulnerability and adaptation. In practice the pathway of mainstreaming was not a linear one. A number of climate-related assessments have been undertaking prior and during mainstreaming process: climate vulnerability and risks assessments, sectoral and institution capacity assessments, gender assessments, institutional capacity surveys, other types of supporting work that contributed to informed inclusion of vulnerability concerns into sectoral development policy documents. Awareness raising and information events (workshops, round tables, bilateral meetings, trainings) with participation of decision and policy makers, ministry and district levels planners, NGO and private sector representatives, other stakeholders had the objectives to highlight the importance of climate change adaptation for Moldova along with seeking the opinions and solutions for identified problems. Another objective of vulnerability and adaptation-related discussions among sector stakeholders was to generate interest and motivation at sector level, so that the decision makers were more receptive to climate vulnerability information and could contribute to the creation of the enabling conditions for adaptation action and resulting into sector ownership of adaption planning and action.

The process of *mainstreaming climate change adaptation into already existing policy framework* at the sector level went through modifications of policies, which was a challenge for both sector and district levels planners and required technical support. Staff knowledge and skills were issues to be addressed from the onset of adaptation planning and required capacity building efforts.

6.3.1. Mainstreaming adaptation into existing sector development planning

Methodological approach. In order to develop robust climate adaptation strategies, correct framing of uncertainty in medium and long-term planning and selection of appropriate approaches, methodologies and tools is of great importance and decision makers have to get comand on them. This totally applies to the mainstreaming of climate change adaptation into medium and long-term sectoral development planning therefore, the methodology of mainstreaming of adaptation context and action into the existing sectoral polices that will help system (sector) to reduce the risks and vulnerabilities and adapt to the impacts of climate change received dedicated support.

The methodology of screening the policy document (plan, strategy) against *climate risks* (applying climate lens) was an integral part of the effort to determine current and future vulnerabilities to climate change and a prerequisite to identify adaptation measures or pathways to reduce those vulnerabilities, increase resilience, and take advantage of any identified opportunities. The steps followed by technical planners in screening a policy document are presented in the flowchart of Fig. 6-23.

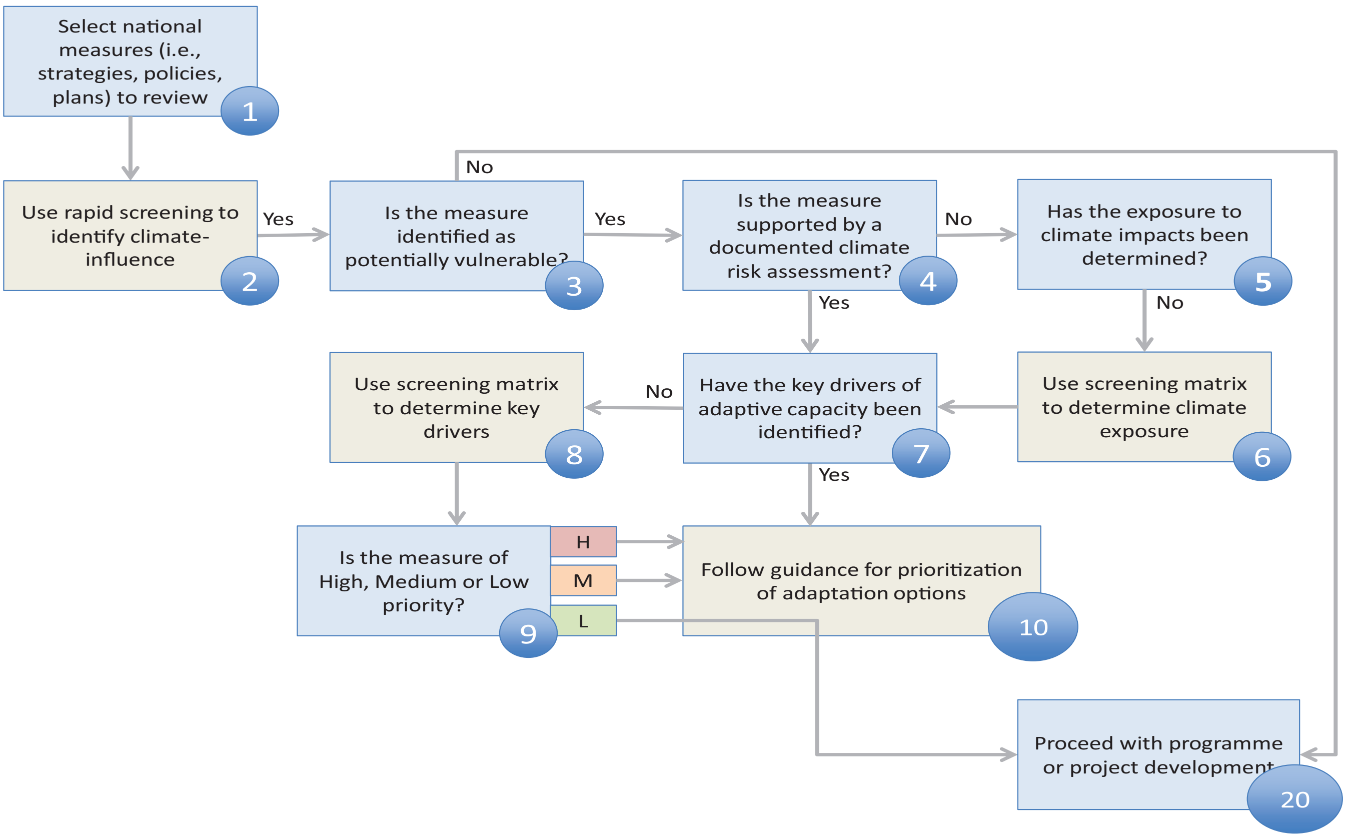


Figure 6-23: Climate Screening Flowchart of a Policy Document for Mainstreaming Climate Change Adaptation into Existing Policy Documents of Moldova.

Applying this approach, decision makers and sectoral planners undertaking climate risks screening of sector development strategies determined whether the subjacent strategic documents have considered the consequences of climate variability or/and climate change in a specific area of interest, even in spite of climate uncertainties and to help it become more resilient to climate change or more supportive of adaptation by understanding the relevant climate change risks and opportunities. The process of identifying risks, but also opportunities from climate change and variability, was an intrinsic part of the overall objective of mainstreaming CCA into the planning process of priority sectors by the sector planners of line ministries. Experience tells that new tools and processes work best when integrated into existing systems so that they become intrinsic to the 'day job' and are not onerous to apply. This is a key issue for Moldova and reflects the recognition that tools and processes have to be designed to work within organizations that have competing priorities, capacity challenges and limited resources, as is the case of line ministries.

At the same time, it was obvious that a more practical, context specific guidance, incorporating Moldovan specifics of policy document evaluation was needed, therefore, based on the experience of CCA mainstreaming of two pilot sectors transport end energy, the methodological guidance *Mainstreaming Climate Change Adaptation into Moldova's Policy and Planning*[203] was developed within ADA/UNDP Project. This methodological tool provides a stepwise analytical approach and structure of mainstreaming procedure.

6.3.2. Mainstreaming adaptation into development planning of energy and transport sectors

One of the first steps of mainstreaming process *was to identify the entry points* for adaptation incorporation at sector level (Fig. 6-23). This step required consideration of entire sector development portfolio and coordination at institutional, sub-sector, sector and national levels for both energy and transport sectors. For transport sector the most appropriate strategic document as an entry point for adaptation mainstreaming was considered *Transport and Logistics Strategy for the years 2013-2022*, while for energy sector *Energy Strategy of the Republic of Moldova till 2030* as comprehensive sectoral policy documents with high impact on sectoral planning. The incorporation of CCA applied the steps mentioned in the Mainstreaming Guide and the following risks and opportunities identified at the sector level. The challenge of mainstreaming was in *ex post* improvement of the development strategic documents. The objective was to provide actionable recommendations for succinct and discrete edits to the existing and enacted Strategy document, through additions or modifications of existing text, in order to achieve a revised document which, while not altering the main strategic thrusts or require an extensive reconsideration of approved strategic orientations (which could risk the acceptance of the recommendations), moves towards a Strategy which is more robust in considering the potential mid to long term implications of climate variability and change to transport and energy sectors.

Energy sector: climate impact, risks and vulnerabilities

Moldova´s strategy for energy is framed in commitments to alignment with the Energy Community[204], to which it associated as full Member in 2010. The Energy Community Acquis Communautaire governs principles of competition policy, as well as legal acts in the area of power, gas, oil, environmental care, energy efficiency and renewable energy. Republic of Moldova is also a partner country of the EU INOGATE energy programme[205], which focuses inclusive on energy security, supporting sustainable energy development and attracting investment for energy projects of regional interest.

The most likely positive impact of climate change on the energy sector in Moldova will be the warmer, shorter winters, which may trigger a reduction in the demand for heating. This will conduct to energy savings that may be considerable, with economic and environmental benefits for families, businesses and the public sector. Reduced heating demand during the winter will most likely impact the use of biomass and natural gas (or other fuels used for heating purposes) but also electricity. Another positive impact may arise from the expected decrease in annual precipitation in that it will likewise entail an increase in the annual solar irradiance. The greater number of sunny days will be beneficial for the performance of solar energy systems (existing and projected). Efforts could be directed to making these technologies (solar PV and solar heat) more widespread.

On the other hand, the risks from the expected negative impacts can be dealt with and are opportunities themselves for transforming the energy sector, with benefits for other sectors as well. The principal climate change and variability pressures for energy sector are the rising temperatures and decreasing precipitation and the increase in the frequency and severity of extreme weather events including storms, floods, droughts and heat waves (extreme heat).

On the supply ***side several main risks could be identified*****:**

- Given that the annual precipitation is projected to decrease, it is likely that the country's potential (and eventual intention) for producing energy from rivers will diminish. River flows are expected to generally decrease and the amount of water that is available (surface and groundwater), which is needed for many different uses – from drinking water, to irrigation, to preserving ecosystems, to generating electricity – risks being increasingly smaller for electricity generation.
- The projected temperature scenarios also pose a risk for electricity generation in the co-generation power plants: i) the temperature of the water subtracted from rivers or reservoirs for cooling purposes may exceed technical limits or, ii) warm cooling water that is discharged into rivers may come to exceed the legal limit values for temperature, particularly on occasion of prolonged heat waves.
- Warmer and drier summers can be a concern for the production of biomass for biofuels. Crop production for fuels risks becoming more expensive (for instance, demanding additional irrigation) or even firewood may become more scarce (there may be less vegetation in a more arid environment).
- 68% of the energy supply in Moldova consists of natural gas imports (IEA, 2012). Warmer summers and heat waves in particular may be of some concern for operating conditions in storage facilities or in distribution. Operators of such services and infrastructure would be well advised to mainstream climate change considerations into their safety measures and operating procedures.
- Extreme events such as storms (with strong winds and/or lightening) and floods, the former for which there aren't clear projections or certainty whether they may come to be more frequent or severe in Moldova, in the future, may threaten supply grids. Power lines, foremost, have been known to be vulnerable to storms and floods (as recently as 2008 and 2009, 2017) which caused local power supply disruptions. Transmission and distribution of electricity may therefore be increasingly under threat if climate change does bring about more of these extreme events.

*On the demand side***.**

- Warmer summers in general, but heat waves in particular combined with higher levels of water stress and scarcity, are a threat to the wellbeing of citizens, crops, livestock and

[203] Yovel E. and Santos S. (2016) Mainstreaming Climate Change into Moldova's Policy and Planning. A simplified User's Guide, Chisinau, Moldova 37 p.
[204] <http://www.energy-community.org/portal/page/portal/ENC_HOME/>.
[205] <http://www.inogate.org>.

wildlife. It is therefore very likely that the demand for air cooling in buildings, commerce and industry will increase. This increase can trigger a surge in the use of domestic and industrial air-conditioning and refrigeration. Thus, energy demand is likely to increase in the summer (particularly demand for electricity), while it may decrease in the winter (less heating will be needed – lower demand for biomass, natural gas and electricity).

- Peak demand during hot summer days may pose a risk to the capacity of the grid (generation, transmission and distribution). Coping with these daily and seasonal changes to the electricity demand curve may prove challenging and require adaptation in order to meet or improve its services as envisaged for the sector in Moldova.

Adaptation opportunities for energy sector

Adapting the energy sector to new climate conditions is seen as: taking advantage of whatever positive effects that will likely arise – opportunities, making changes in the existing systems so as to make them ready for the likely new climate conditions and resilient to whatever risks that may arise.

For both cases, measures were designed with a focus on aligning the adaptation with the objectives that are envisaged for the energy sector in Moldova, this includes seeking to avoid conflicting with other sector strategies in place and complementing them and exploring co-benefits (Table 6-20). These strategies come together in the concept that climate change scenarios are likely to imply for the design, operation and maintenance of infrastructure, in other words, integrating climate change risks and opportunities into the design, operation, and management of infrastructure[206].

The most likely positive impact of climate change on the energy sector in Moldova will be the warmer, shorter winters, which may trigger a reduction in the demand for heating. This will originate energy savings that may be of a considerable amount, with economic and environmental benefits for families, businesses and the public sector. Reduced heating demand during the winter will most likely impact the use of biomass and natural gas (or other fuels used for heating purposes) but also electricity.

Another positive impact may arise from the expected decrease in annual precipitation in that it will likewise entail an increase in the annual solar irradiance. The greater number of sunny days will be beneficial for the performance of solar energy systems (existing and projected). Efforts could be directed to making these technologies (solar PV and solar heat) more widespread.

On the other hand, the risks from the expected negative impacts can be dealt with and there are opportunities for transforming the energy sector, with benefits for other sectors as well.

CCA measures for energy sector have been designed to:

- *Promote energy efficiency.* Measures designed to promote energy efficiency target the supply side as well as the demand side. On the supply side the focus should be on modernising the current energy production capacities and reducing transmission and distribution losses. Modern energy generation technologies are more efficient at converting energy than older systems. Planned maintenance is also important to keep machinery and transmission equipment in good operating conditions in order to minimize losses[207]. On the demand side, policy, regulation and incentives can focus on improving energy efficiency (and generating savings) in all consumer segments – residential, commerce and business, industry, public services, agriculture, and transports. This can be achieved by introducing or improving energy standards, building codes, tax benefits, subsidies, tariff incentives, etc. Some of the measures area already listed as components of the *National Energy Efficiency Programme 2011-2020*, which is committed to increase the efficiency of use of overall primary energy by 20% by 2020, relative to 2009. These policy instruments should be accompanied by awareness-raising campaigns which can be tailored for each segment. Within these measures, the ones that promote thermal insulation of buildings will likely produce the greater benefits as they will produce energy savings from heat and cooling, while contributing to flatten the demand curve (in the summer).

[206] UNDP, 2011 Paving the Way for Climate-Resilient Infrastructure: Guidance for Practitioners and Planners. Official Proceedings – International Conference: Strategies for Adapting Public and Private Infrastructure to Climate Change. San Salvador. <www.unccelearn.org/sites/www.uncclearn.org/files/inventory/undp_paving_the_way.pdf>.

[207] Electricity transmission in particular may come to experience a marginal increase in losses along the cable lines in the hotter conditions arising from warmer summers and heat waves.

Table 6-20: Climate Change Risk and Opportunity screening of the Moldova Energy sector

Component	Climate Change Risk	Opportunities for Adaptation (and avoiding maladaptation)
Natural gas sector	• Increased natural gas consumption due to rising domestic electric charge; • The deterioration of environmental conditions for crop growth forest climate, it poses a serious threat to energy production from biomass.	• Implementing energy efficiency measures; • Sorting of waste and biogas from biodegradable household waste; • Implementing projects for installation of solar collectors for domestic hot water heating; • Increase consumption of natural gas in areas where there will be shortage of combustible materials (pellets, briquettes, bales of straw).
Electric energy sector	• Increased demand for electricity caused by the increase in summer temperature and the need for indoor air climate; • Increased demand for electricity for irrigation caused the decline in soil moisture insurance; • Increased electricity losses due to rising air temperatures and lengthening the duration of the cooling system operating electrical equipment; • Increased duration of unplanned interruptions to electricity supplies increase the frequency of cases caused by wildfires in the protection of overhead lines;	• Insulation of buildings and promotion of modern room-conditioning systems (eg heat pumps); • Develop programs coordinated development of power grids and construction of farmland irrigation stations; • Develop regulations on electrical equipment requirements limit to the newly purchased one???, to reduce the climate impact on electricity grids and reducing energy losses; • Strengthen the regulatory framework for the promotion of energy efficient technologies within energy companies (including the approval of tariffs and enabling long-term reinvestment of savings achieved from reducing losses); • Create common regulation of the Ministry of Economy, Ministry of Environment and other stakeholders, the protection areas of networks; • Electric energy market liberalization and integration into ENTSO-E. Implementation of differentiated tariffs for electricity and construction in the southern republic of pump-storage hydropower plants (CHEAP) to settle the load curve in the national energy system.

Component	Climate Change Risk	Opportunities for Adaptation (and avoiding maladaptation)
Thermal energy sector	• Reduce heat demand due to rising mean annual temperature and shortening the cold period; • Decrease capacity of generating electricity and heat at power plants District (CET) caused by insufficient thermal load; • Increase water losses caused by the diminishing capacity of the cooling towers MGRES condensation heat.	• Implement technologies cogeneration heat and power based on gas turbine combined cycle steam turbine; • Create near CHPs and MGRES of free economic zones for economic production from fields in technological processes using steam; • Construction in nearby MGRES CHPs and refrigerators to preserve fruit and vegetables, producing cold with steam.
Energy efficiency sector	• Increase energy intensity caused by the increase in electricity consumption for air conditioning and irrigation;	• Insulation of buildings; • Energy labelling; • Implement building energy performance certificates; • Introduction of new forestry crops with higher tolerance to heat stress and water scarcity;
Renewable energy sector	• Decrease power generation capacity of HPP caused by diminishing water flow in the rivers Prut and Nistru result of lower rainfall; • Diminishing quantities of biomass due to higher occurrence of droughts; • Reduce the quota of renewable energies in the electricity system that ensures stability due to decreasing availability of balancing energy; • Reduce crop capacity growth will cause oily liquid biofuels produced smaller amounts.	• The construction of wind farms, where wind potential will increase due to the increase in mean annual temperature; • The construction of solar power stations (photovoltaic) generation potential had risen; • Electric energy market liberalization and integration into ENTSO-E. Implementation of differentiated tariffs for electricity and construction in the southern republic of pump-storage hydropower plants (CHEAP) to settle the load curve in the national energy system.

Flatten the (electricity) consumption curve. It is beneficial for the operation of the grid and the power plants that the daily demand curve be more predictable, stable, and flat (less peaks in number and in magnitude). However, there is the risk of the emergence of more intense demand peaks in the electricity grid due to a surge in cooling and air-conditioning systems in buildings, during warmer summer days. The need for new, expensive and under-used peak load capacities for electricity production will be greatest for Moldova as a country that didn't yet reached full market saturation of air-conditioning appliances. However, much of this may be avoided by promoting passive cooling techniques or solar-based appliances in buildings and cities or by defining a minimum threshold for their installation in offices and public buildings[208].

Risks from demand peaks can also be countered by measures that promote better insulation and building codes as well as stricter energy efficiency or performance standards for appliances. It can also be done by introducing (or enhancing) dual (or other multiple) tariff plans. Such tariff plans can be designed to change consumer behaviour – benefiting energy consumption in off-peak hours and penalizing it in peak-hours. This behavioural change is easier nowadays given that a growing number of household appliances, industrial machinery, and public equipment, are automated, connected and can de (remotely) programmed.

Adaptation measures in energy sector

After screening energy sector strategic documents against climate risks and undertaking vulnerability and sector capacity assessments, the national experts in collaboration with sector planners, other stakeholders have identified the adaptation measures to be implemented by the sector.

- The main CCA measures identified for mainstreaming into energy sector strategic document are:
- Restoring the electrical stations equipment of transport networks, for rime/frost melting/ or introduction of new defrosting technologies such as PETD (Pulse electro-thermal de-icer);
- Elaboration of coordinated development programs of electrical networks and construction of farmland irrigation stations;
- Construction of additional water systems of CHPs from alternative sources
- Creation of free economic zones (FEZ), close to CHPs and MGRES, for economic production from sectors that use steam or hot water in technological processes (greenhouses, absorption refrigerating equipment, processing of agricultural raw materials, etc.);
- Implementing the Energy Management Standard (ISO 50001:2012 "Energy Management Systems. Requirements and Guideline") for energy and private companies in order to increase energy efficiency and reduce energy intensity.

Construction of an excess energy storage plant produced by wind farms and photovoltaic power plants with energy storage purposes and its use when there is lack of wind and sun, to balance the electric charge of the national power system (NPS).

Each of proposed adaptation measure was desegregated into a set of adaptation actions (Table 6-21) and in some cases up to project level with details for justification on the needs and benefits of mainstreamed measure into the sector development policy documents.

[208] Discussion Paper: Impacts of Climate Change on Regional Energy Systems. ESPON applied research project on natural and technological hazards. <www.espon.eu/export/sites/default/Documents/Projects/AppliedResearch/ReRISK/RERISK-Discussion-Paper-Climate-Change.pdf>.

Table 6-21: Implementation actions of restoring the electrical stations equipment of transport networks, for rime/frost melting/ or introduction of new defrosting technologies such as PETD (pulse electro-thermal de-icer) adaptation measure

Nr	Action	Implementation time	Performance indicators	Responsible institution	Costs thousand MDL	Costs thousand USD
1.	Inventory of the equipment for the ice /rime melting existing at the electric stations	Q III, 2017	Inventory register completed	„Moldelectrica" Agency	520	26,113

Nr	Action	Implementation time	Performance indicators	Responsible institution	Costs thousand MDL	Costs thousand USD
2.	Producing a feasibility study on electrical grids against frost deposits. (with consideration of mechanical and electrical technologies of frost removal, zonal reinforcement of EGs and implementation of early warning systems)	Q III, 2018	Feasibility study produced	Ministry of Economy, SHSM Moldelectrica Agency „RED Union Fenosa" Co SA RED-Nord-Vest, RED-Nord Co	1500	75,326
3.	Supplier selection and completion of delivery contracts for the required machine.	Q IV, 2018	Needed equipment delivered	Moldelectrica Agency „RED Union Fenosa" Co SA RED-Nord-Vest, Co RED-Nord	125 + the costs of the equipment estimated at a later phase	6,277 + the costs of the equipment estimated at a later phase
4.	Identification and contracting of the executors of the required works for the construction, assembly and adjustment of the warning system.	Q II, 2019	Warning system in place	SHSM	To be estimated	To be estimated
5.	Analysis of climatic changes and new technologies to remove the frost from the electrical grids components.	2030		SHSM Ministry of Environment, Ministry of Economy	260	13,056

CCA measures of energy sector were subject for consultation at sector (Ministry of Economy, Department of Energy) and sub-sector levels (19 subordinated institutions) until consensus achieved.

Transport sector: climate risks and vulnerabilities

The main hazards for transport sectors are floods, droughts and heat waves. According to climate projections, the Republic of Moldova is likely to be increasingly exposed to these hazards both in frequency and severity. Climate risks for the transport sector are directly related to the hazards (and combination of hazards) and to the nature and condition of transport infrastructure in the country.

Floods, droughts and extreme heat can individually or in combination increase strain and fatigue to transport infrastructure over land, particularly roads and railways. Floods can cause short-term delays and interruptions but also long-term interruptions and detouring needs in the event of destroyed infrastructure[209]. Droughts, seasonal and annual reduced amounts of precipitation – as projected – will render reduced river flows which in turn will compromise the navigability (which is poor already) of the waterways. The two main waterways – rivers Nistru and Prut – may be affected and therefore shipping (passengers and freight) conditions may become more complicated. The possibility of shipping in these waterways will require greater efforts and measures. Rising temperatures may come to affect airport runways in the same manner as they will paved roads, possibly affecting air travel if unchecked.

Transversally, the thermal comfort of passengers in vehicles may be increasingly compromised with rising temperatures in the summer. Moldova is already experiencing a greater demand for cooling systems in passenger vehicles and larger capacity for the transportation of refrigerated goods (in case the existing goods can no longer be transported without artificial cooling during warmer summer conditions).

Another concern is the budgetary needs for the maintenance of adequate transport infrastructure and vehicles (road, rail and water). Such needs risk being increasingly bigger or not being met altogether under current climate projections.

Indirect costs to users of transport systems and the economy as a whole are potentially significant. If transport services are disrupted, then there is a considerable cascade or indirect effects for other industrial sectors, including movement of labour and materials[210]. This could be particularly problematic for the overland transport of perishable agricultural products such as fruits, which are very relevant to the Moldovan economy.

On the other hand, climate change impacts may trigger changes in the organization of the society and the output of the economy, both of which can in turn change the transport sector. If for example agricultural production gradually falls (productivity has been projected to decrease by as much as 18% by 2039 with respect to 1961-1990[211]) due to climate change or if atypically poor agricultural years such as 2003 and 2007 come to be more frequent, there may be less overall demand for the transportation of goods.

Climate risks for the transport sector are therefore both directly imposed by new weather trends and events, and indirectly imposed by changing transportation patterns brought about by other affected sectors.

Roads. Roads in Moldova are currently regarded as in unsatisfactory condition. In 2006 only 7% of the roads were qualified as good or satisfactory[212]. With the expected increase in the number and severity of floods and droughts that will affect the country, soil erosion, land movement (to the extreme, landslides) and intensified surface runoff can be expected to increase as well. The occurrence of these phenomena adds strain to roads, the most exposed of which may subsequently be subjected to flooding, flash floods, erosion and washout. Many roads may therefore be at risk of structural damage from extreme weather events brought about or intensified by the expected climate change. A particular case to be wary of, for its likely greater detrimental effects, will be hot and dry spells followed by heavy local rains associated with storms and hail. Due to outdated and ineffective storm drain systems in urban centres, flooding is common in some intersections and road segments, such as in Chisinau in 2005, 2008 and 2009, 2015, 2016.

Unpaved roads – typical of the rural regions – are more likely to be negatively affected by the projected change in precipitation patterns as they are generally more vulnerable to severe rainfall. Increased moisture in the warmer, wetter winter season may likely render the roads muddy and impracticable.

[209] EEA Report No 8/2014 – Adaptation of transport to climate change in Europe. Challenges and options across transport modes and stakeholders <http://www.eea.europa.eu/publications/adaptation-of-transport-to-climate/at_download/file>.

[210] IEEP, Milieu, Ecologic Institute, GHK, Environment Agency Austria, 2012. Methodologies for Climate Proofing Investments and Measures Under Cohesion and Regional Policy and the Common Agricultural Policy <http://ec.europa.eu/clima/policies/adaptation/what/docs/climate_proofing_en.pdf>.

[211] Centre for Climate Adaptation <http://www.climateadaptation.eu/moldova/agriculture-and-horticulture/>.

[212] Centre for Climate Adaptation <http://www.climateadaptation.eu/moldova/transport-infrastructure-and-building/>.

Some rural communities (about 40)[213] are already subject to isolation due to impracticable transit during periods of intense precipitation, and this may increase with warmer and wetter temperature patterns observed.

The structural integrity of the national paved (asphalted) roads may be at an increasingly greater risk also from higher temperatures, particularly extreme heat. Temperature is a significant factor that affects the performance and service life of asphalt pavement. High temperature of pavement makes asphalt softer, increasing the risk of rutting (depression deformation) due to plastic deformation, which in turn decreases the pavement evenness and consequently affects the traffic safety. For heat waves spanning for several days and above 40°C serious rutting of the pavement is to be expected. Intense heat related damage to roadworks was registered in 2003 and 2007 in the Chişinău-Balti highway and the Chişinău-Leuseni national highway, which was subject to rehabilitation shortly before.

Railways. Railroads are generally found to be in a better condition than roads. They are therefore and likewise vulnerable to changes in the climate, particularly extreme heat.

Extreme heat can cause deformation (buckling) of the railroad lines. This is a risk in Moldova as summers become (mildly) warmer and (significantly) drier, a greater number of heat waves is also expected. Metallic parts of bridges will also be at structural risk from persistent high temperatures in the summer. This will require effective maintenance monitoring systems, but will also inevitably reduce speed and load of trains.

On the whole, rail transportation – passengers and goods – will very likely be at risk of disruption (episodic or permanent) or subjected to significant delays and reduced average speed of trains, particularly in the older lines and/or the lines currently in worse condition.

Intense heat will require more power load from engines and cooling needs for passenger cabins as well as some kinds of freight transport, including agricultural or other perishable goods, both of which will lead directly to higher fuel-related operational costs.

Waterways. With warmer, drier summers (as much as 64% less yearly precipitation), shipping in Moldova may well become increasingly complicated and expensive. The river flows of the Nistru and Prut in the summer may see significant reductions, which makes them impractical for navigation. There is a risk that waterways may become impractical for shipping – passengers or freight – in the summer and autumn, or in particularly dry years. The accumulation of mire, the inadequate use of dams and the lack of dredging that is necessary for ensuring the adequate depth for vessels' traffic is already a problem which may be aggravated by future climate change.

Shipping in Moldova may become increasingly unfeasible in practical, technical or economic terms. Significant investment, including heavy engineering works may be required to secure a sound river transportation system.

Airports. At airports – the Chisinau International Airport, foremost - there is a risk that increasingly warmer temperatures in the summer may gradually cause a greater level of wear and fatigue to the runways, similar to the heat stress on roads. Warmer temperatures decrease the resistance of the pavement to plastic deformation and rutting as explained above. In the event of persistent hot summer days (heat waves) with temperatures above 40°C, severe rutting of the paved runways may be expected. The gradual or rapid deterioration of the pavement of the runways can ultimately stifle air traffic – arrivals and departures – and endanger landing and take-off manoeuvres. In order that air traffic at the airport continues to run smoothly and uneventfully, runway maintenance or even resurfacing may become required sooner and more frequent than previously expected. On the other hand, de-icing requirements and respective costs may reduce during wintertime under climate projections.

Adaptation opportunities in transport sector

The transport sector plays a critical role in supporting the functioning of Moldova society and economy. It facilitates accessibility of services that are vital for business and for the livelihoods of the people. It also enables economic growth and job creation.

Climate risks for the transport sector – as summarized above – are foremost related with the generalized poor condition and significant vulnerability of the transport infrastructure – more importantly that connected with road and rail transport, but also air and water transport – to current weather patterns and more so to projected future climate. The poor condition of roads is already a significant constraint to economic growth and poverty alleviation in remote areas; the negative impact of climate change on roads could further marginalize those isolated communities that already suffer from a lack of access to the national labour and product markets[214]. It is therefore reasonable that adaptation measures focus on reducing the vulnerability of transport infrastructure in Moldova by increasing its resilience.

With regard to floods it is likely that they will intensify with increased rainfall. In Moldova this is likely the case in adjacent areas of the Nistru and Prut rivers (and well as several smaller inner rivers). This is a concern for any transport systems in those regions, mainly in the winter season. Roads and railroads (and bridges or any other infrastructure) need to be resistant to heavy rainfall, soil erosion, landslides, washout and floods to a reasonable extent in order to avert the worst negative impacts such as temporary disruption and structural damage.

The risk of roads being impractical for transit (temporarily or seasonally) due to mud (in case of unpaved roads) or to becoming severely flooded is not restricted to the flood-prone regions of the Nistru and Prut rivers – roads throughout the country generally lack adequate drainage systems. The water collection system is outdated and unable to accommodate heavy rain episodes[215]. With forecast future climate this problem will likely be of greater concern and therefore better drainage systems are needed for roads, railroads and other transport infrastructure in order to limit damage and transit disruption and improve safety and accessibility. Road works, rail works and similar interventions should be designed as to increase resistance to heavy rain and floods – an opportunity for adaptation.

[213] UNDP, 2009. Climate Change in Moldova – Socio Economic Impact and Policy Options for Adaptation. National Human Development Report, 2009/2010, Chisinau <http://hdr.undp.org/sites/default/files/nhdr_moldova_2009-10_en.pdf>.

[214] UNDP, 2009. Climate Change in Moldova – Socio Economic Impact and Policy Options for Adaptation. National Human Development Report, 2009/2010, Chisinau <http://hdr.undp.org/sites/default/files/nhdr_moldova_2009-10_en.pdf >.

[215] Centre for Climate Adaptation <www.climateadaptation.eu/moldova/transport-infrastructure-and-building/>.

Adaptation measures that target improving existing networks or building new roads or railroads should also consider reducing the exposure of such infrastructure to floods. This can be done by knowing flood risk maps, prudently selecting or changing routes and adopting adequate construction solutions – opportunities for adaptation.

The efforts required for climate proofing the transport sector can be eased and its respective effectiveness improved with support of other structural and non-structural measures. Measures such as source control (watershed/landscape structure management), laws and regulations (including zoning, infrastructure building codes, vehicle specifications and traffic codes), and flood risk assessment systems will contribute to the resilience of the transport sector. The conception, design and revision of these types of measures are regarded as opportunities to include considerations about resilience to floods and heavy rain events (and to avert maladaptation).

The resistance of roads, rail tracks, airport runways and bridges or other transport infrastructure during the heat waves along with steady and gradual increase in temperature should be ensured to a reasonable extent. In order to avert negative impacts such as asphalt rutting, railroad buckling and other structural deformations, roads and railroads are to be built and maintained to withstand projected excess summer heat. An anticipatory approach is therefore necessary for planning new infrastructure or improvements.

Rising summer temperatures decrease the thermal comfort of passengers and increase refrigeration requirements for freight – a problem that can be solved by a more widespread use of air conditioning and cooling systems in vehicles, stations, airports and other such infrastructure. As with road and rail planning and projects – new or renewals –considerations on requirements for cooling/refrigeration for vehicles are be included and regarded as an opportunity of adaptation. Vehicles and transport equipment in Moldova are be adapted to projected future climate so as to remain adequate or further meet the country's needs, with particular attention to be paid to public transports and infrastructure.

The positive effects of climate change were considered to be opportunities to be taken advantage of:

- Reduced humidity throughout the year (except in the winter) will likely reduce the risk of landslides and soil erosion which persistently affect roads in Moldova. If roads are gradually designed and (re)built to withstand the winter humidity conditions they will be more than prepared to withstand the summer conditions. As rainfall becomes less frequent in the summer so will episodes that originate traffic disruption and infrastructural damage. Losses of productivity and recovery costs will decrease.
- Warmer winters (the baseline negative winter mean temperature of -2.1°C can increase to as much as +2.4°C by 2080) will likely soften the requirements for snow and ice control measures on roads – the savings of which can be reapplied in improving the quality of the surface through use of thicker layers of asphalt and less viscose materials[216].
- Similarly, the higher temperatures to come in the winter may have a positive effect at airports by reducing the costs of de-icing planes and removing snow and ice from the runways.

The Table 6-22 summarises the risks and opportunities of climate change affecting the transport sector, as well as the risks for mal-adaptation.

The examination of climate change risks to the transport sector resulted in a series of adaptation options for the different transport subsectors for further sector concept development and economic assessment. As referred, the key strategic document for the mainstreaming of climate change adaptation opportunities into the transport sector is the *Transport and Logistics Strategy for 2013-2022*[217].

[216] Centre for Climate Adaptation <www.climateadaptation.eu/moldova/climate-change/>.
[217] Strategia de transport și logistică pe anii 2013-2022, Aprobată prin Hotărârea Guvernului nr.827 din 28 octombrie 2013.

Table 6-22: Climate change risk and opportunity screening of the Moldova transport sector

Components	Climate Change Risks	Opportunities for adaptation (and avoiding maladaptation)
Road Transport	Significant variations in temperature Intense rainfall Surface deformations caused by asphalt temperature, rain, snow. Reduced public transport circulation and / or increased costs that will affect first of all vulnerable groups (including older women, children, etc.) Damage to bridges and viaducts caused by heavy rains Damage to the health of technical personnel involved in the maintenance and repair of roads	• Development of new materials for use in road construction that is resistant to high temperatures. • Design and construction of street pavement tolerant to heat waves. • Grinding cracks roads • Adapt stations harmless cooling systems. • Use of road asphalt that is more resistant to cracking. • Promoting technologies of asphalt sealing against water intrusion. • Promoting effective road maintenance technologies. • Assess the impact of new roads climate change. • Improve flood protection. • Improving monitoring water levels. • Upgrading drainage for roads. • Upgrading technology design, construction and maintenance of roads in the context of climate change. • Restrict traffic in extreme periods (winter and summer). • Speed limits on certain sections of road. • Prohibit movement of vehicles weighing more than the allowed limit. • Development of affordable transportation networks, especially in rural areas • Replacing the pavement on bridges and viaducts. • Covering deformed pavement surfaces on bridges with a protective layer • Restrict traffic on bridges and viaducts. • Construction of reservoirs around bridges • Use of specialized equipment. • Shortening working days. • Increase the frequency of medical reviews

Components	Climate Change Risks	Opportunities for adaptation (and avoiding maladaptation)
Air Transport	Surface deformation of runways for take-off and landing of aircrafts	• Restrict take-off and landing aircraft during heat waves. • Lengthen runways. • Design of additional runways • Upgrade existing runways with materials tolerant to temperatures • Operationalization of Marculesti, Cahul, and Balti airports
Water Transport	Navigation routes become impassable due to low water levels or climate events (droughts and floods) Population migration from the nearby settlements can impede further development of water shipping (passengers and freight)	• Creating a specialized body for the management of waterways. • Equipping ports with facilities and equipment for collection, storage and use of waste from ships. • Procurement of equipment necessary for cleaning river beds • Construction of additional ports. • Procurement of equipment adapted to the waterway use • Widening rivers. • Continuous maintenance of navigable routes. • Planting forest bands on river banks. • Construction of overflow water reservoirs

The following mid- and long-term adaptation measures for transport infrastructure have been proposed to sector:

- Conducting a vulnerability study of transport infrastructure (roads, railways, airfields, and waterways) based on the best climate change projections;
- Reviewing technical normative documents for design, construction and maintenance of transport infrastructure (roads, railways, airfields and waterways), and their adjustment to future climate change projections;
- Evaluation of the technical and investment condition of roads, bridges, viaducts, airfields to climate change (evaluation of transport infrastructure adaptation capacity);
- Conducting research on the design and development of advanced materials and technologies aiming to increase the resilience of roads, railway lines, airfields, harbors to climate change risks;
- Conducting a feasibility study on covering down a layer of thermal and waterproof protection of the bridges;
- Conducting a feasibility study on repairing and covering with an anti-thermal material the road sectors of Chişinău - Giurgiuleşti (M-3), Chişinău - Bălți and Chişinău - Leuşeni (M-21);
- Adjusting urban and landscaping plans to future climate change risks in transport infrastructure (roads, bridges, railways, waterways, airfields);
- Creating a research-analysis-evaluation platform regarding insurance to climate change risks with an impact on transport infrastructure, using insurance companies;
- Training the decision-makers that manage the construction of transport infrastructure, in climate risk conditions;
- Conducting a study on installing hydrophilic and thermophilic forest bands on roads, waterways, railway lines, with increased climate risks;
- Conducting a study on reducing weight limits, operating speed of weight transportation and traffic intensity (road, rail) in areas with high climate risks;
- Cleaning the riverbed, straightening and deepening waterways of main rivers (the Nistru and Prut);
- Development of the investment plan, prioritized on sectoral adaptation needs, coordination of the plan with development partners;
- Development of a monitoring and evaluating system/ mechanism for the implementation of adaptation measures to climate change in transport infrastructure;
- Economic and environmental potential assessments for road, rail, air, water transport, promoting a shift to less polluting transport;
- Adjusting procurement procedures and terms of reference (ToR) of infrastructure investment projects to climate change issues;
- Electrification of railway lines and modernization of locomotives;
- Identification of advanced/ efficient technologies to improve the collection and disposal of rainwater from the road network;
- Identification and implementation of corporate management and technologically advanced models of transport infrastructure construction to climate change;
- Purchase endowments necessary for cleaning and widening riverbeds, and develop a system for monitoring their status and navigability;
- Promotion and application of new/ advanced technologies for covering bridges and highways with a layer of thermal and waterproof protection.

6.3.3. Mainstreaming adaptation into sector planning through sector-specific adaptation policies

Mainstreaming of CCA into sectoral development planning of Moldova was applied also through the development of sector *specific climate change adaptation strategies* and their implementation *action plan*, taking various mainstreaming requirements, in particular climate change and variability into consideration from the onset that acknowledges and integrates those concerns and uses them to help shape the strategy. Development of sectoral strategies is considered a way of framing climate problems and formulating sector specific policy responses to current and future climate changes. This was in line with the *ex-ante* approach to integrate climate change into a sector strategic document. Stakeholders from health and forestry sectors showed initiatives and interest in developing a sector specific adaptation strong enabling environment based on policy framework.

Development of sector specific policy documents helped building capacity by raising awareness and enhancing preparedness among the institutions, sectors and all involved stakeholders. In both cases, a working group and inter-sectorial committee were created, composed of representatives form the lead institution (Ministry) and stakeholder representatives.

It was assumed that the capacity built within sector's teams during the process of preparing the policy documents will facilitate and catalyse the design of other sectors adaptation policies or programs of action.

Climate Change Adaptation Strategy of Health Sector

Climate variability and change are exacerbating many current climate-sensitive health outcomes and have the potential to affect the ability of health system institutions of Moldova to maintain or improve health burdens in the context of changing climate and development patterns of the country.

Health sector climate impacts, risks and vulnerabilities

Floods, droughts, storms, heat waves, cold spells as extreme weather events create direct injury risks and follow-on outbreaks of infectious diseases, lack of nutrition, and mental stress of citizen of Moldova.

Floods are reported as rivers overflowing banks, but for Moldova they are to be taken into account also as drainage failure in urban environments, in particular, Chisinau city. The latter is quite frequent in the recent years due to the increasingly uneven distribution of rains that tends to concentrate in heavy rains lasting a few hours. In October month 2016 for the first time during the observation period of 60 years the amount of water (100-185 mm) exceeded 4-6 times the average monthly amount. Weather events clash often with insufficient maintenance of the urban drainage and irregular damping of waste and generate devastating urban floods, along with landslide in rural areas, whose risk prevention and control is matter of maintenance and infrastructural investments.

Drought-related impact on health is mediated through likelihood of food insecurity, with catastrophic effects on the national economy as in 2007 and 2012, that decreased the quality of life, produced changes in lifestyle, caused population migration from rural areas to cities and out of the country and increasing tension over water resources associated with inadequate sanitation and low quality drink water supply.

Heat waves and cold spells. Climate change is already experienced by the citizens of the Republic of Moldova through an increased trend in high-temperature heat waves, typically associated with medium to severe drought throughout the country. Climate change increased the frequency and severity of heat waves, offering no relief and posing a particular threat to children, elderly, other vulnerable groups of persons in the cities, in particular in Chisinau, the capital of Moldova. In 2016 the SHS in several occasions has issued yellow code warning of hot weather during July-September months.

Excessive daily heat exposures create direct effects, such as heat stroke, reduce work productivity, and interfere with daily household activities. The health outcome has been documented for Chisinau in relation to the heat waves occurred in 2007 that accounted nearly 190-200 deaths in excess i.e. nearly 6.5% increase in mortality along with high incidence of respiratory diseases can support the public health concern for such a weather event. The number of days with maximum air temperature + 30°C and higher during June-July months in 2012 constituted 38-46 days, that drastically affected whole economy and human health.

Also in the *cold spells* event, the adaptive measures to reduce the vulnerability of the health system strongly relies both on structural investments, undertaken to increase the resilience of the whole country – as poverty reduction, housing improving mainly for disadvantaged people - and on socio-economic policies, as the affordability of the gas for heating, school ambient maintenance and health services affordability for non-affluent families.

In this regard, the incidence of the tuberculosis (TB) in Moldova has constantly increased up to 180 new cases / 100,000 and stabilized at a rate of 67 in 2015. TB represents both a severe concern for public health in Moldova and a factual indicator of poor livelihood conditions, including poor housing, overcrowding, late diagnosis, affordability of cures. Climate change can exacerbate thus the incidence of TB during cold periods or getting difficult its progressive eradication.

The winter months are actually getting warmer, but the absolute minimum of recorded temperature are low (-25°C; -27°C), creating more extreme seasonal differences and between seasons difficulties when interpreting human climate exposure issues from annual averages.

The *secondary impacts* of climate change occur via ecosystem alteration and other interactions, including changes in the distribution and prevalence of diseases and vectors. All above mentioned climate hazards, acting separately or together, have great implications for both human health and survival, affecting different societal groups of Moldova in different ways.

Climate change impact on public health of Moldova may enhance health effects from extreme weather events through:

- increasing the malnutrition in rural areas, where population is particularly dependent on crop and livestock productivity,
- changing foodborne disease patterns,
- changing the distribution of infectious diseases and potentially contribute to the establishment of tropical and subtropical species,
- increasing the burden of waterborne diseases in populations where water, sanitation and personal hygiene standards are already low,
- increasing the frequency of respiratory diseases resulting from changes in air quality and pollen distribution,
- creating displacement of populations because of river flooding and agricultural disruption.

As a developing country, Moldova's population health is dependent on the stability, productivity and resilience of the natural environment. Many of the health impacts of climate change referred to above are a particular threat to poor people that is why the vulnerability of health sector of Moldova is also associated with *poverty*. Climate change adverse effects on economic growth poses challenges to various economic sectors of Moldova and affects the reduction of poverty in the country. The incidence of poverty is higher in villages of Moldova. Although the poverty rate has declined during the period 1999-2016, a large number of rural population lives under the poverty line. In 2013 the national poverty rate was 12.7%, most affected are rural population and large families. Among households with three family members the poverty rate is 13.3%, while in those with 5 or more persons -28.0%.

It should be pointed out that the climate change impacts on rural communities of Moldova also interact with several other major concerns, such as *population aging, availability of primary health services*, and other infrastructure, as well as corruption that undermine efficient reductions in social inequalities. The *high price of gas* for household heating represents a problem for a substantial part of the population since cold and humid living environment can facilitate the diffusion infectious disease, including TB and respiratory diseases. Moreover, the high price of heating services diverts families' income from other investments, including primary health care and prevention. The cost of the energy for a family expressed as percentage of the household income spent to afford gas, coal electricity and water bills, represents the 20% of the family expenditure in Moldova. The percentage of health service costs borne by families is high, the burden for the Moldovan families is the highest and equal to the 50% of the service. In this case it is evident that climate change adaptation's measures will overlap with the sustainable principles of the country investments, not only in the environmental defence and infrastructural works, but also in the price and fiscal policies.

Under the climate change, the food production system in Moldova is affected by multiple stresses – from water shortage, soil exhaustion, biodiversity losses (which can affect pollination, control of pest species and soil nutrients). *Food insecurity in* the conditions of Moldova appears in cases when severe climatic factors, such as drought, flooding and hail, could ruin the crops, leaving farmers without food and income, which means that both urban and rural population may face serious nutritional risks. The magnitude of damages potentially caused by weather events depends also on the environmental depletion. Therefore, failing the defence of the local economy threatened by floods, drought, storm and hail, a progressive loss of wealth of living population rises, which facilitates further loss of land and productivity. The loss of productive means and the increase of economic constraints for households forces people to emigrate and cause forest depletion due to illegal logging, which causes soil erosion and landslide. In Moldova people who have lost means of production often migrate abroad or to towns, taking subordinate jobs or increasing the urban poverty, which is burdening as well the health system and so forth.

Increased values of *general mortality* ranks Moldova among the countries with the highest mortality in Europe. In 2016 the general mortality accounted for 1,083.60 cases per 100 thousand inhabitants. Most frequently deaths are caused by diseases of the circulatory system (57.5%), followed by tumors (14.5%), chronic gastrointestinal diseases (9.1%), injuries, intoxications and other external cause (7.8%), diseases of the respiratory apparatus (4.8%). Another feature is the high mortality at active age – 456.2 deaths per 100 000 inhabitants (696.4 in men and 201.0 in women), accounting an average for 44% of the total number of deaths (the share of men is 60% and women-23%).

Strong concern is brought forward by external causes of death, in which accidents, injuries, unsafe working environment, casualties from disasters and conflicts and so forth are reported. A SDR[218] 3-fold higher than that measured in EU average could configure a high vulnerability to environmental exposure, including weather events. Moreover, such a huge mortality rate due to external causes appears to be concentrated in the working age group. As reported by the EU Observatory on Health System, the reduction of life expectancy through death before 65 years of age is 12 years for male and 6.4 for female.

The high mortality reported in Moldova for infectious and parasitic diseases appears to be in relation with unsafe water or water scarcity, which is a cause of inadequate sanitation and hygiene (Table 6-23 and 6-24). However, high rates of described mortality are also strongly related to low health service access, poor housing and poverty in general.

The *respiratory diseases* are the 5.6% of the total mortality and represent the fifth cause of total deaths men having mortality 2.1 times higher than women due to respiratory diseases and argue that this excess can be related to outdoor work. The monitoring of PM10 and PM2.5 concentrations in winter is of key importance in order to reduce harmful exposure which can operate as a multiplier for the adverse acute health effect potentially caused by the cold.

Table 6-23: Mortality by all causes (general mortality), by age groups for male and female 2013

Age group	Population of Moldova		Number of death all causes		SDR x 100,000	
	Male	Female	Male	Female	Male	Female
0-1	20,054	18744	181	178	2.3[119] (0-4 y)	2,3[120] (age 0-4)
1-9	176,502	165894	87	57	0.5 (5-9 y)	0,2 (age 5-9)
10-19	225,745	215558	94	56	0.8	0.5
20-29	344,226	332259	389	130	2.3	0.8
30 - 39	274,663	272012	797	250	5.9	1.8
40 –49	220,969	238695	1,591	623	14.5	5.2
50- 59	234,324	275473	3,979	1819	34.4	13.4
60 -69	127,303	167481	4,435	2932	68.9	35.6
70-79	64,006	108811	4,886	5444	159.2	103.5
80+	24,554	52224	3,437	6695	291.43	268.2

Table 6-24: Selected causes of mortality females and males

Indicator	2004		2013	
	M	F	M	F
All CVD (SDR)	617.6	686.9	583.8	657.2
External causes and poisoning … (SDR)	168	117.2	199.3	133.8
Respiratory diseases (SDR)	94.3	46.3	69.5	28.2
Infectious and parasites diseases / gastro intestinal and related diseases (SDR)	593	157	346	96
Liver diseases and cirrhosis (No. of cases per year)	1492	1724	1,269	1244
Infant mortality, age 0-1	13.72	10.41	9.3	9.6

The *overall incidence* in Moldova in recent years is maintained at the level of 3500-3600 to 10.000 inhabitants (Tables 6-25 and 6-26). The highest is the incidence of respiratory diseases (1084.3 to 10 thousand inhabitants), traumatic injuries, intoxications and other consequences of external causes (520.6 to 10 thousand inhabitants), infectious diseases

[218] SDR = Standardized death rate
[219] Only standardized rate of death
[220] Only standardized rate of death

and parasitic diseases (281.4 to 10 thousand inhabitants), digestive diseases (236.9 to10 thousand inhabitants), etc. The incidence in children is more than twice higher than the overall incidence of adults.

Overall prevalence remains very high - 7274.5 for adults and 7891.9 for children to 10 thousand inhabitants of the respective age. In the Republic of Moldova it is conditioned, primarily, by the respiratory diseases (1308.5 to 10 thousand inhabitants), diseases of the circulatory system (1249.2 to 10 thousand inhabitants), followed by diseases of the digestive system (931.1 to 10 thousand inhabitants), traumatic injuries, intoxications and other consequences of external causes (524.4 to 10 thousand inhabitants), etc.

Since becoming an independent country, in Moldova a constant decrease in the incidence of communicable diseases (NCDs) has been noted due to the implementation of disease control and health promotion measures. However, the prevalence of tuberculosis (TB) and HIV/AIDS diseases remains high. Incidence rates for NCDs have remained consistently high since the early 2000s.

Table 6-25: Population morbidity in the Republic of Moldova

Population morbidity	2008	2009	2010	2011	2012	2013	2014	2015
Registered patients								
total, thou. persons	2,445.5	2,623.9	2,621.7	2,703.2	2,682.1	2,740.5	2,745.7	2,831.4
per 1000 inhabitants	685.5	736.3	736.3	759.5	753.5	770.1	772.1	796.7
Registered ill persons, with the diagnosis set for the first time								
total, thou. persons	1,154.2	1,288.2	1,234.1	1,259.5	1,178.1	1,190.0	1,127.0	1,161.3
per 1000 inhabitants	323.5	361.5	346.6	353.9	331.0	334.4	316.9	326.7

Source: Statistical Yearbook of the Republic of Moldova, 2016.

Table 6-26: Population morbidity by main cause of disease

Indicators	2013	2014	2015
Diseases of the circulatory system *(thou cases)*	539.3	570.4	582.5
Malignant neoplasms *(thou cases)*	73.1	75.0	75.5
Diseases of the respiratory system *(thou cases)*	515.3	485.2	553.9
Diseases of the digestive system*(thou cases)*	329.6	331.1	332.3
Infections and parasitic diseases *(thou cases)*	121.5	119.9	118.0
Diseases of the digestive organs *(thou cases)*	329.6	331.1	323.3
Injuries and poisoning*(thou cases)*	121.5	105.6	107.2
TB *(per 100 000 inhabitants)*	3050	2747	2373
HIV carrier *(per 100 000 inhabitants)*	13	12	13
Viral hepatitis B *(per 100 000 inhabitants)*	2	1	1

Source: Statistical Yearbook of the Republic of Moldova, 2016.

Air pollution with sulphur dioxide, formaldehyde, and other pollutants generated by transport is another negative factor influencing urban population health. The risks of cardiovascular system, respiratory and cancer increases are high in the polluted environment (Table 6-27). Exposure to air pollution is the cause of diseases such as ischemic heart disease, myocardial infarction, stroke, and chronic obstructive bronchopneumonia and lung cancer, in case of children determine predisposition causing acute respiratory infections and asthma. Statistical data show correlation between the disease incidence and air pollution in 2004 and 2014 years, during 10 years the annual concentration of NO_2 increased by 12.5%, and the incidence of respiratory disease in children <1year by 20%.

Table 6-27: Diseases incidence caused by air pollution for 2004 and 2014 years

Indicators	2004	2014
NO_2 annual mean concentrations	*40μg/m3*	*50μg/m3*
Incidence in general population, all diseases per 10.000	4204.5	4153.7
Incidence in children <1, respiratory diseases	765.5	886.4
Mortality rate of CVD all ages, per 100.000	652.25	625.05
Mortality rate of respiratory diseases all ages, per 100.000	70.3	48.85

Source: Statistical Yearbook of the Republic of Moldova, 2016.

Environmental modification and vector borne diseases. The progressive warming and related prolonged hot or mild time period carry on both positive and negative effects for the whole country. Amongst positive effects, the reduction of primary energy intake and the extension of the vegetative period for crops and fruits are to be accounted (Table 6-28).

Table 6-28: Vector borne diseases incidence (Lime disease, Nile fever, other): period 2010-2014

Vector borne diseases	2010		2011		2012		2013		2014	
	Recorded cases	Incidence per 100.000	Recorded cases	Incidence per 100.000	Recorded cases	Incidence per 100.000	Recorded cases	Incidence per 100.000	Recorded cases	Incidence per 100.000
Borrelioza	117	2.86	171	4.18	189	4.70	104	2.55	106	2.61
Encefalita acariana	0	0	2	0.0489	1	0.0249	0	0	0	0
Coxiella burnetii	5	0.1221	2	0.0489	2	0.0498	0	0	5	0.12

Amongst negative effects, there is evidence of an increased spread of parasites, pollens, algae and disease related to vectors as ticks, lice, midges and mosquitos. The National Centre of Public Health of Moldova reports around 100 case/year of Lyme disease that is transmitted by ticks. The possible increase of the number of cases due to climate modification is however unknown, but also hard to assess. Very few cases of Nile Fever transmitted by the Aedes Aegipticus mosquito are reported by the Centre. No other vector borne diseases are reported or monitored. The epidemiological surveillance is part of the infectious diseases monitoring system which works effectively.

The material resources of the health sector, primarily hospital sector, inherited from the USSR times are outdated. Maintaining hospitals in functional condition is expensive due to excessive surface inefficient heating system, high costs for repairs. Many of the health care units do not have the resources available, what affects the quality of health services rendered. The documents regulating procurement methods of medical supplies (medicines, food, disinfectants, detergents, etc.) still do not ensure the prompt implementation of transactions. For this reason the late procurements affect the quality of health services, which often turns into an impediment for the proper functioning of the hospital system and other medical facilities. However, in the recent years beneficial changes take place in the health sector, conditioned by the financial support from the development partners with focus on the primary health care, as well as the hospital care.

Lack of medical personnel (doctors and nurses) limits the effectiveness of the primary, secondary and specialized health care systems. The number of physicians per 10 thousand inhabitants reported in 2015 was: total 36.6 and 29.3 – in the system of the Ministry of Health. Supplementing public health care facilities with doctors in 2015 was 86.8%, many of them having part-time employment in several places. At the same time, there is an oversupply of doctors in urban areas, while in rural areas the situation is opposite. The current shortage of doctors in rural areas originates form the limited number of family doctors, along with high percentage of doctors approaching the retirement age. The share of positions occupied by paramedical personnel in 2013 was 96.8%, with part-time employment in several places.

Dual employment status of the medical staff (as employees in the state and private companies) allows for the possibility of reverse circuit of patients: patients, who apply for health services, are often referred further to private establishments where the same staff is employed. This situation affects the costs of routine health services for cases of illness caused by the occurrence of extreme climate phenomena.

Cross-sectors. Managing the health risks of climate change requires engagement with more than just the health sector. SHS are needed to provide data on weather trends and projected climate change. There is a large number of sectors, such as water, agriculture, transport with programmes and activities that could affect health. Ensuring engagement with these sectors is another key to providing more successful health outcomes.

Health Sector Adaptation Strategy

Republic of Moldova public health response to the issues caused by the climate change was formulated in the sector specific document *Climate Change Adaptation Strategy of Health Sector and Related Plan of Actions till 2020*. Policy document was developed by the sectoral Working Group (WG) supported by technical experts as prevention strategy based on adaptation actions considered effective in reducing increasingly likely threats to health of citizens of Moldova (Table 6-29).

The vision of the strategy is to ensure that Republic of Moldova's population is more protected by increasing resilience and capacity of health sector to adapt to the climate change, with the overall goal of reducing vulnerability and health risks by implementing measures contributing toward health sector adaptation to climate change.

Table 6-29: Climate Change Adaptation Measures/Actions of Health Sector of Moldova

Health system functions	Measures/actions for the floods drought. Storms and hydrological risks	Measures/actions for the heat waves and cold spells	Measures/actions for the environmental modification and vector borne diseases
Health governance and policies	Clear roles and delegation of tasks amongst the SPESS[221], health authorities, SHS also in view of risk assessment and risk communication. Advocacy and inter-sectorial coordination in order to promote, monitor and report on: • urban drainage maintenance, urban rivers banks maintaining, waste disposal care and well designed, sewage system upgrading, • water stock assessment and improvement, water emergency wells digging in coordination with AGMR[222], safe water provision in rural areas; • groundwater quality assessment and treatment, also through the modernization of the AGMR; • rural areas supplied with safe water; • transport system improvement in flood-prone areas, • hill forestation/slope maintenance for landslide risk reduction.	Awareness increasing campaign with regard to healthy behaviors in case of heat waves (night and day), life style, nutrition and alcohol abuse during cold periods. Advocacy and sectorial coordination in order to promote, monitor and report on: • green belts and greening the cities, urban woods also aiming at absorbing Nitrogen and smooth Ozone generation; • fuel prices and energy affordability for the general population; • housing and public transports costs and general affordability • rules and laws for a progressive housing insulation during refurbishing; • rules and laws new building according to international insulation standard; • district heating systems for new settlements, mainly if for deprived families housing; • urban and country road maintenance and refurbishment according to international road safety standard.	Awareness increasing campaign with regard to healthy behaviors in case of vectors spread and mainly outbreaks due to a sudden parasites and insects spread. Advocacy and sectorial coordination in order to promote, monitor and report on: • compliances with international quality standard in husbandry and agricultural products; • safe cattle husbandry norms and regulation in coordination with the state veterinary service.
Human resources for health	Heath officers training on emergencies management; Institutional link between the CPESS and the health sector, Working group for health risk assessment and communication Health officer trained and specifically designated for leading communication	Heath officers training on heat waves emergencies management; Health officer trained and specifically designated for population awareness increasing and risk communication.	Heath officers training on new coming potential threats Health officer trained and specifically designated for population awareness increasing with regard to vectors spread, hygiene and safe behaviour in case of insects related outbreaks.

[221] CPESS: Civil Protection Emergency Situations Service.
[222] AGMR: Agency for Geology and Mineral Resources in charge of the sampling and stock assessment of the ground water in Moldova.

Information systems	Task force for epidemiological surveillance on infectious diseases; Health officer designated to be in contact with the meteorological and geological services for early warning mainly for drought. Advocacy and sectorial coordination in order to promote, monitor and report on: • Creation of a network of rain meters network whose data are able to elaborate the SPI index shall be installed for droughts' forecast. • Implementation of the early warning system for flood risk in the critically exposed areas. • Rescue and relief stocks to be placed, available and checked in municipalities at risks of flood and landslides.	Strengthening the health information system (IS) by assigning to well identified entity the task to analyze data and report on: respiratory diseases morbidity and mortality with special focus on tuberculosis and groups of population as workers and ageing people (65+); infant mortality 1-5 years by causes; • epidemiological surveillance of specific diseases as asthma; • cardiovascular mortality by age group; • external causes mortality by age group with focus on road- and out-door worker accidents. Advocacy and sectorial coordination in order to promote, monitor and report on: • The SHS to produce daily concentration of CO, NO_x, SO_2, ozone and particulate matter recording and reporting according to the international standards • SHS to produce forecast on heat wave and cold spells early warning; • SHS to produce forecast UV radiation and thermal inversion phenomena early warning.	Review / strengthening the national research agenda on vectors related diseases spread and morbidity danger; Review / strengthening the national research agenda on pollens and moulds health risk; Review, identification and updating on risks in order to tune the epidemiological surveillance according to specific / changing threats, if any. Advocacy and sectorial coordination in order to promote, monitor and report on: • entomology monitoring on the spread of ticks, lice, midges and mosquitos; • pollens and new species, botanic monitoring; • monitoring on emerging and new plants parasites.
Essential product and technologies	Provision of ceramic filters to clean water in house to householders and farmers Advocacy and sectorial coordination in order to promote, monitor and report on availability of potable water supply chain.	Emergency wards fully operational for cardiovascular diseases in all main down-town and country hospitals.	Diagnosis capabilities and drugs to face vector diseases such as Lyme diseases, Nile fever.
Service delivery	Availability and stock in exposed municipalities of rehydration solutions and drugs for gastro-enteric diseases	Availability and stock checking in rural areas of food, fuel, stoves, blankets and so forth to face cold spells in remote areas and / or dispersed settlements.	
Financing		Increase of the general affordability of the health services mainly for disadvantaged families; Effectiveness analysis of the public health insurance / funding system.	Increasing of the general affordability of the health service for early diagnosis and prevention.

The general objective of this strategy is to strengthen health sector capacities to prevent, prepare and respond to climate change events. This objective is supported by the specific objectives, under which the adaptation measures are grouped:

- Ensuring functional cooperation between the relevant sectors and institutions for a coordinated approach and efficient use of available resources.
- Information and public awareness on climate change and extreme weather events effects on health.
- Development of efficient mechanisms for prevention, early warning, management and control of heat waves effects generated by climate change.
- Reducing air pollution and cold waves effects on health
- Establishing an integrated and efficient system for prevention, early warning management and protection against increased levels of ultraviolet radiation
- Improve the prevention and control of infectious diseases influenced by climate change.
- Establishing a system for control and prevention of allergic diseases caused by pollen in the climate change context.
- Establish a system for prevention, early warning, management and mitigation of climate change induced floods and droughts
- Increasing the resilience of health facilities to climate change and developing "green" health services.

In numerous occasions, the WG of health sector mentioned that resource implications for adaptation action of public health are a challenge at sector and sub-sector levels. Effective improvement of climate resilience and adaptation to on-going and future climate change will require high expertise at national and local level and according to ICA results, this is a resource issue.

The up-front and continuing cost of adaptation measures creates another resource limitation issue for health sector. The health sector also needs to develop knowledge and skills in local prevention/adaptation programmes, in order to reduce the cost of treatments for rural population.

Climate Change Forestry Sector Strategy of Republic of Moldova

Forestry Sector Climate Impact, Risks and Vulnerabilities

Moldova's forestry sector mostly consists of state-owned forests (87.5%), administered by the State Agency Moldsilva that is responsible for forestry and hunting policymaking and management; and LPA forests (12.4%), and managed by village or municipal level LPAs.

Moldova's forests are under multiple pressures and can suffer of a number of biotic and abiotic damage common to Europe's forest areas. The projections for the Republic of Moldova indicate that extreme events with a rare incidence of temperatures of 34-35°C for the reference period 1961-1990 will become averages of the summer temperature maxima in the future. More general predictors at European level show that flood risk is rising in Eastern Europe and droughts (with a current incidence of a 100-year event) will be repeated on average at 50 years and even more frequently in Southern and Eastern Europe, including the Republic of Moldova. At this time, most of the country is characterized by arid climate or semi-arid climate, but weather forecasts show that aridity, which leads to an increased incidence of droughts, will increase significantly by 2040. Moreover, aridity will become expressed in the plant growing season from June to October months. Researchers anticipate that minor changes in temperature and rainfall can severely affect the growth and future survival of the forest, especially in limiting ecosystems such as many of forest ecosystems in Moldova.

Climate change impacts on species at the individual level may be negative or positive depending on regional level climate change conditions. Hornbeam (*Carpinus)* and ash are the most vulnerable species, the ash *(Fraxinus)* showing a 20-40% decrease in biomass accumulation. The lime tree is expected to show greater growth until 2040 followed by a steady decline. Beech *(Fagus sylvatica),* located at the lower end of its natural area, will show a decrease in biomass production of up to 50% by the year 2050, but in the short term it has the capacity to participate in the development of stable forest ecosystems and productivity. Sessile oak (*Quercus petraea*) seems to be less affected by the new climatic conditions, with projected increases in volume by 2090 followed by steady decreases. Pedunculous oak *(Quercus robur)* is less scientifically documented internationally but of particular importance in Moldova. Pubescent oak (*Quercus pubescens*), seems to have a high capacity to adapt to climate change, having the ability to maintain its growth and especially vitality and in higher temperatures and drought, of course, if there is a variability Significant population genetics.

The development and maintenance of a compositionally diversified and climate adaptive forest is a significant challenge for forestry sector of Moldova and will require measures including research on species selection, adaptive origin and genotypic studies of native species.

The *Climate Change Adaptation Strategy of the Republic of Moldova* identifies a series of effects of climate change on the forestry sector, including: increasing the length of the vegetation season, endangering species sensitive to temperature changes, increasing vulnerability to forest fires, deteriorating phyto-sanitary condition, changes in the composition of the stands. During the development of *Forestry Sector Climate Change Strategy* other risks with regard to invasive species, modification of adaptation capacity of native species, change of success rate of forest regeneration, have been identified. These climate effects have socio-economic consequences: impoverishment of firewood, reduction of biodiversity, reduction of forest regulatory effects in the field of soil erosion, landslides, floods, etc.

The major climate important risks identified by the specialists in the field are changes in the composition of the stands, competitive behaviour of the species, the rate of regeneration of the forest, the phytosanitary conditions, sensitivity to pests. Opportunities due to climate change are limited because the effects of rainfall and temperature increases are diminishing in the country's climatic conditions of increased CO_2 concentration. For this reason, increasing biomass production is considered an opportunity only in the northern area of the country. On the other hand, the role of the forestry sector in the mitigation of the effects of climate change through the sequestration of carbon in biomass is recognized. Concern about the extension of the area of forest land is a constant one and reflected in the sectoral priorities set out in various program documents already adopted or in the process of adoption, built upon already existing significant experience in implementation and monitoring of carbon projects under the Clean Development Mechanism of the Protocol Kyoto. This experience is useful in attracting and implementing projects in this area of activity, which can support emission reduction efforts.

The development of sector–specific strategic document was done by the Working Group of Forestry Sector consisting of forestry experts, decision makers, sector planners and researchers. Preparation process of the Strategy was participatory and inclusive involving and considering opinions, comments of participating actors, including the aspect of incorporating mitigation component. After the stakeholders consultations and assessing the expectations and needs of the sector itself and the organizations within the sector and common work undertaken with sector WG, the recommendation was made to expand the strategy elaboration from a strategy dealing strictly with the climate change adaptation to a strategy to tackle all the climate change challenges, establishing effective links between climate change mitigation and adaptation, of the forestry sector in the Republic of Moldova. One important reason for that was the fact that the main mitigation measures to be implemented are dealing with the extension of forest surfaces through afforestation and are very closely linked with the adaptation measures approaching extreme phenomena like landslides and floods.

The strategy vision defines the main directions of action for the duration of next decade of the forest sector to adapt to the consequences of climate change and mitigating the effects of climate change. The policy document sets up an integrated adaptive management response at the sector level through improvement in forestry planning based on monitoring of forest productivity and species distribution, other factors. The strategy is seen as a proactive document that allows for social learning and flexibility in responding to environmental feedbacks and promotes medium to long-term resilience for socio-ecological systems, adaptive management being a central component.

The goal of the strategy is to enhance the contribution of the forest sector and forestry ecosystems to adapt the social and economic development of the Republic of Moldova to climate change impacts and to achieve implementation of the current level of mitigation commitments assumed by the association at the Copenhagen Agreement.

The general objective of the Strategy is to increase the capacity of the forestry sector of the Republic of Moldova to adapt to the consequences of climate change by maintaining and improving the capacity of forest ecosystems to provide services to society and by maximizing their capacity to contribute to mitigating the effects through the increase of carbon dioxide sequestration capacity by 2020 by 25% compared to the reference year (1990) within the land use sector, changes in the land use and forestry management. Ecosystem-based Adaptation (EbA) approach that recognizes that ecosystem services and plays an important role in reducing people's vulnerability to climate change was incorporated into the developed Forestry Sector Strategy. The importance of ecosystem services is acknowledged in all eight objectives of the Strategy. During the development of sectoral strategy, WG members have identified the main climate risks the sector faces along with adaptation opportunities (Table 6-30).

Table 6-30: Climate Risks and Opportunities of Forestry Sector of Moldova

Climate change risks	Adaptation opportunities
Changing forest composition due to different sensitivity of species to temperature and precipitation	Stimulating research on the relationship between adaptability of native tree species to climate change. Reconsider forestry practices in adaptation context.
Changes in the competitiveness of species (including increased species and organism competition with an increase in tree mortality)	Stimulating research on the relationship between adaptability of native tree species and climate change. Reconsider forestry practices for their adaptation.
Changes in the forest stand structure (including density)	Reconsider forestry practices for their adaptation
Changes in species peculiarities with regard to regeneration	Adapting forest regeneration practices to the needs of climate change
Increased incidence of *Limantria* attacks and *Tortrix viridana* in oaks and other species	By continually investigating, identifying interactions related to climate change, alternative species, and appropriate attack management strategies
Spread of pathogenic pathogens from other geographic regions that adapt to climate change	Take immediate action in case of relevant alerts. Hold regular meetings with specialists, amending if necessary import or domestic phytosanitary regulations
Increasing the survival capacity and fecundity of game species that can affect forest plantations	Adoption of local level strategies for the management of herds
Spreading of invasive plant species, new or existing	Collaboration with regulators, agricultural, forestry, local authorities, etc. Planning collaborative control strategies and eradication where impact shows signs of being significant
Wind blasts	Immediate elimination of effects by harvesting wood, promoting pivotal rooting species.
Mass drying phenomena	Adopt management measures to eliminate severely affected stands without compromising regeneration capacity. Adoption of appropriate regeneration compositions. Continue research into adapting species to climate change
Increase the incidence of forest fires	Enhancement of collaboration with specialized fire-fighting agencies. Adoption of preventive measures. Adopt rapid intervention regulation, including the revision of fire extinguishing equipment

The strategy strongly emphasizes the adaptation needs of existing forestry system of Moldova, in particular the potential roles of species diversification, the fostering of mixed stands or the promotion of alternative forest operations that may vary according to the rates of growth characteristic of a particular location and the predicted timescale of risks from projected climate change.

This Strategy aims to be an efficient way of achieving the maximum potential of the forestry sector in the Republic of Moldova in the shortest possible time to adapt to the predicted climate changes and to mitigate their overall effect. This strategy defines the main lines of action for the next 9 years to adapt the forestry sector to the consequences of climate change, to maintain a normal flow of forest ecosystem services and to mitigate the impacts of climate change on the forestry sector.

Strategy implementation *Action Plan* (Table 6-31) includes ecosystem activities for social well-being or adaptation, with most of them in support of other adaptation measures (e.g. infrastructure). These activities deal mainly with regulating services (soil rehabilitation, erosion control) and provisioning services (fuel wood). They also have the potential to promote integrative and cross-sectoral adaptation, as many of them consider multiple ecosystem services and beneficiary sectors.

However, more technical, political and financial support is needed to foster the role of ecosystem services in adaptation at the implementation stage. Each of the activity mentioned in the Table 6-31 was disaggregated to the action level with specific details of its implementation.

The consultation process with line Ministries and civil society was taken over by the Ministry of Environment (currently *Moldsilva* Agency is a subordinated institution of the Ministry of Environment) and developed sector specific policy document has to be approved through a Government Decision.

Table 6-31: Action Plan and Specific Objectives of Forestry Sector

Specific objectives and their implementation activities
1. Protection and management of existing forest areas
1.1. Sustainable forest management
1.2. Minimizing the possibilities of changing the destination category from land with forestry to other land categories.
1.3. Promoting and using forest systems and practices that protect carbon stocks.
2. Create new forest areas adapted to the consequences of climate change and able to efficiently capture carbon and produce biomass.
2.1. Expanding the forest fund by afforestation of degraded land.
2.2. Expanding areas covered with forest vegetation outside the forest fund.
2.3. Expanding energy crops.
3. Facilitating ecological adaptation of forests through ecosystem approach.
3.1. Promoting adequate management in the network of valuable forest ecosystems.
3.2. Promoting the connectivity of valuable forest habitats.
3.3. Adapting forestry operations practices to climate change and prioritizing forest types and species vulnerable to climate change.
4. Adapting forest regeneration practices to the needs imposed by the climate change.
4.1. Reconsider genetic conservation in the forest area under the climate change.
4.2. Revision of practices on forest regeneration and extension.
5. Minimizing environmental risks from climate change.
5.1. Management of the risks of pests, diseases and natural disasters on forests.
5.2. Combating the instability of the slopes in areas susceptible to landslides.
5.3. Increasing forest contribution to combat erosion of rivers and lakes.
5.4. Use and enhance the practical potential of forestry in flood risk management.
5.5. Reconsidering the concept of forest protection strips to protect the field, including by adapting the compositional structure of existing forest strips to new climatic conditions.
6. Adapting the use of wood to climate change.

Specific objectives and their implementation activities
6.1. Optimizing the use of wood for energy purposes and diversifying renewable energy sources.
6.2. Increased use of woodwork.
6.3. Reducing the carbon footprint of the forest sector.
7. Promoting awareness and good understanding of climate change and how the forestry sector can make a positive contribution.
7.1. Stimulating cooperation with other sectors.
7.2. Increase the capacity of the sector to implement mitigation and adaptation measures.
7.3. Stimulate cooperation with civil society and promote educational programs.
7.4. Promoting and implementing information to the general public.
8. Monitoring of adaptation and mitigation actions in the forest sector.
8.1. Adaptation monitoring activities

6.3.4.Mainstreaming climate change adaptation into local (district) level development planning

The mainstreaming of adaptation into the strategic planning process at the local level required additional context specific work based first and foremost, on a proper understanding of the major climate threats to socio-economic development of local territorial-administrative unit. Therefore, at the initial stage of mainstreaming process, it was important to carry out the analysis of the local economic capacity, a scanning of the social, economic and environment vulnerabilities and establishing of clearly defined goals with regard to local resilient development considering appraised adaptation priorities.

Based on the *Vulnerability Index* developed for 32 districts of the Republic of Moldova within Third National Communication of Moldova to UNFCCC (2014) the Local Public Authorities (LPAs) of six most vulnerable districts of the country (two pilot districts of each Development Region of Moldova) *Falesti, Singerei, Nisporeni, Calarasi, Leova and Basarabeasca*, with help of national experts mainstreamed climate change adaptation into existing district level socio-economic development strategies (LDS) and their implementation action plans.

Similar to sector level, an important step was to identify and agree on the entry point of mainstreaming CCA into the district level strategic planning. The methodology described in the developed *Mainstreaming Climate Change Adaptation into Moldova´s Policy and Planning* Guide was applied in screening of local development strategies (LDS) and action plans (AP) of six districts against climate risks and assess them in the light of climate change projections and impacts: *Integrated Development Strategies of* Falesti (2013-2020), Singerei (2012-2020), Nisporeni (2013-2020), Calarasi (2012-2020), Leova (2015-2020) and Basarabeasca (2013-2017) districts. Based on the screening results of these documents the work was undertaken to:

- identify appropriate adaptation measures to be implemented at the local level and mainstream them into the existing LDS and AP;
- review current spending on activities that could be considered climate resilience, climate change adaptation measures, disaster risk reduction as well as effectiveness of these allocations assessed;
- identify appropriate financial instruments and mechanisms through consultations with stakeholders, a comprehensive literature review, and building on international and regional best practice and applied to existing spending budget.

A stocktaking of available information with regard to climate change impact at local level considering the available information (sector and local level documents, studies and statistical data, geographical, historical, demographic, economic, and environment information) was conducted. For each of the 6 districts a climate profile at district level was developed based on temperature and precipitation indicators, along with peculiarities of extreme climate events and climate risks specific for each district. Undertaken climate risks screening helped to reveal the risks at the local level, along with adaptation opportunities of the sector considered in LDS: agriculture, water, health, roads infrastructure, energy, forestry.

The activities ensured a properly aligned approach to addressing CCA at the local level in accordance with the national strategic documents (*National Climate Change Adaptation Strategy,* etc.). The mainstreaming approach encompassed also the design of appropriate financial instruments and mechanisms through budgetary planning, allocation and implementation (performance based budgeting) to address climate change adaptation needs, in accordance with the priorities established in the local development policies/strategies.

Concurrently was applied SWOT analysis, based on which strong aspects with regard to climate adaptation were emphasized, along with identified weaknesses and threats. These aspects were further analysed from climate change perspectives and modifications proposed to be mainstreamed into the narrative part of development strategies.

Identification of CCA measures. The identification of adaptation measures was done by the District Councils members that formed the working group of each district through an extensive consultation process and with help of adaptation experts. Considering local needs, a set of adaptation measures have been identified and proposed for incorporation in prioritized sectors of every district: agriculture, water, health, roads infrastructure, energy, and forestry. In most of the cases the proposed measures were structured in a dedicated chapter as part of the LDS or incorporated into each LDS chapter. Working group of each district identified and prioritised the measures aligned to local economic development. Prioritized adaptation measures were disaggregated into concretely defined actions and associated estimative costs along with an implementation timeframe, monitoring indicators, responsible institution/agency for implementation. For identified measures a feasibility evaluation based on economic, environmental, technical and managerial criteria was carried out.

A concern expressed by the working groups during the whole process of adaptation mainstreaming was the allocation of resources, as local level budget faces big constrains. Therefore, the prioritization of CCA measures, mobilization of local resources and intensification of cooperation between local government, civil society and national and international economic agents and donors to implement adaptation action at local level was seen as one of the major task of District Councils.

The consultation process of this activity encompassed discussions and meetings with LPAs of 6 districts and carried out by the working groups on proposed amendment of LDSs to incorporate CCA measures and operationalization of associated performance based budget. Involvement in consultation process of other stakeholders such as economic operators and civil society local representatives enlarged the knowledge of climate related issues and modalities to address them and addressed in the developed climate change adaptation component of LDS.

The consultation procedure of each strategy was an extended one, followed by the approval process of proposed adaptation measures and restructured budget by the Districts Councils and it implied many coordination meetings and supporting activities. During the substantive work carried out, it was important to emphasize the need of building partnerships between the public and private sector (PPP), encouraging business representatives' involvement in the decision-making process within regard to climate adaptation. The final decision of mainstreaming in each district individual of a set of adaptation measures and on restructuring related budget was formulated as a *District Council Decision*, with specifics on the timelines, entities responsible for implementing the activities, entities responsible for monitoring the implementation, other details.

Embedding new knowledge and understanding of CCA into existing Local Public Authorities structures expanded and strengthened their capacity to implement adaptation interventions in priority sectors. Mainstreaming climate change adaptation into the district level development strategies improved the uptake and sustainability of the development process, as district communities develop a strong sense of ownership and their priorities are met.

6.3.5. Promoting gender equality in climate change adaptation

6.3.5.1. Gender as a cross—cutting issue of the Republic of Moldova's institutional arrangement and policy framework

Within undertaken Institutional Capacity Assessment (2014-2015) a number of gaps at the systemic level with regard to gender equality and climate change adaptation were revealed which were later addressed at all levels of adaptation planning and implementation.

In Moldova there are policies and programs designed to address quite a high percentage of people living below the poverty line, but line ministries have limited capacity to address gender issues in reducing the risk of climate change. With the exception of the Ministry of Labour, Social Protection and Family, other government structures have a weak understanding of gender issue.

Analysis of sectoral policies disclosed that most sectoral documents are gender neutral and contain no express reference to gender considerations and do not address relevant systemic gender indicators (socio-demographic, health, etc.). The exception is CCAS that addresses gender sensitive issues in a limited manner and the regional development policy that contains some gender sensitive indicators. Further, there is a lack of gender studies and analysis related to the impact of climate change on vulnerable populations in the different sectors which leads to a distortion of current assessments. Such capacity is needed to support government-wide interventions aimed at reducing climate impacts on vulnerable populations.

The main impediments to inclusion of the impact of climate change on gender and vulnerable groups are:

- at the organizational level, the Ministry of Labour, Social Protection and Family and the Ministry of Health has a limited mandate to address climate change issues and there is a need to increase the knowledge of ministry staff on climate change impacts;
- there is a need to integrate poverty alleviation, humanitarian assistance, local and sectoral development with knowledge of climate change adaptation to better understand how it may affect gender and vulnerable groups;
- insufficient cooperation between the various sectors hinders the development and promotion of gender integrated policies.

While climate change is not included in the Ministry of Labour, Social Protection and Family mandate, it is a potentially effective channel for distributing information about climate change and adaptation, particularly because it works through existing relationships at the community level.

At an individual level, although women have direct knowledge and experience with climate threats, their individual adaptive capacity is very low, particularly among rural women living in poverty.

A number of activities have been designed and implemented during 2014-2017 to leverage the understanding of gender equity in relation to climate change adaptation in Moldova.

6.3.5.2. Building institutional and individual capacities and tools for mainstreaming the gender issue into the policy documents

As a cross-cutting issue, gender requires action in many sectors and at multiple levels. In the activities supporting the National Adaptation Planning Process of the Republic of Moldova, gender mainstreaming was seen as an aspect that requires special attention but also as an important factor in adaptation to ensure efficiency, success and sustainability of implemented activities. Therefore, gender mainstreaming into the adaptation planning and implementation activities along with dedicated gender activities was a priority requiring concentrated efforts, as in the Republic of Moldova gender equality in various sectors is still not correctly perceived and treated in a superficial language.

A successful collaboration between the Ministry of Environment and the Ministry of Labour, Social Protection and Family and CO UNDP was established during the development of new *Moldova Gender Equality Strategy for 2017-2021*. A dedicated chapter of this policy document addresses the issue of gender and climate, in particular, climate adaptation. During the consultation process and public discussion of policy document, comments, recommendations and suggestions have been discussed with further incorporation into the strategy narrative and its implementation plan.

National experts on gender have collaborated with sectoral working groups during the development of policy documents and made conceptual clarity on gender issues with regard to climate change, along with methodology to be applied in mainstreaming of gender equality in sectoral policy framework (Fig. 6-24).

Figure 6-24: Capacity building events on mainstreaming climate change adaptation through gender perspectives into development planning at sector and districts levels.

Gender lens and engendering approach were applied in screening newly developed adaptation policy documents of forestry and health sectors. Gender analysis was performed based on: a) existence of gender indicators, b) text gender sensitivity, c) impact of adaptation measures on women and men, d) involvement of women and men in decision-making, e) assessment of the size of climate change risks for women and men, f) costs and resources for ensuring gender equality. The same gender screening approach was applied to already existing in place sectoral development policies of transport and energy sectors for their further amendment. The analysis of various situations, including climate conditions along with men and women understanding of the impact of various legislative practices, cultural policies and programs on women and men and their relevant adjustment in the context of climate change was an important message to be brought to the decision factors and technical planners at sector level when engendering policy documents either already existing or newly developed. Engendering strategic sectoral policies made gender visible highlighted the gender dimension of adaptation planning and action.

Mainstreaming gender equality into socio–economic development planning at the district level along with adaptation component, necessitated a strong cooperation between gender and climate experts and LPAs of Singerei, Basarabeasca, Falesti, Leova, Calarasi, and Nisporeni districts. Gender mainstreaming into development planning required consideration of specifics of each district, where the understanding of gender issues in the local context had many challenges and required additional gender expertise.

Considering sectoral approach of CCA in Moldova, a *set of indicators* for gender sensitive development in the context of climate change adaptation planning was proposed to stakeholders for discussion and comments, with their further use for monitoring at the sector level. Gender disaggregated data were collected to the extent possible at the sectoral level through the incorporation of indicators into the sectoral policy documents. Stakeholders commented on the need to consider international experience and best practices in gender mainstreaming into policies, harmonisation of national programs, and coordination of actions among multiple implementing actors. Other discussed challenges referred to women access to and involvement in production, dissemination, and management of resources such as energy, transport, forestry, agriculture. The indicators were validated during the stakeholder workshop and recommendations have been considered in further development of sex-disaggregated indicators of the National Bureau of Statistics. Unfortunately, the database does not fully integrate climate-gender indicators. A more rigorous approach to climate-gender nexus is reflected in cross-sectoral indicators of Climate Change Adaptation Coordination, Monitoring and Evaluation. The sectors will collect and report gender disaggregated data to NCCC. Moldova Women Association has representatives in the *National Commission on Climate Change of the Republic of Moldova*, it Coordination Mechanism, with involvement in the adaptation planning process, coordination, monitoring and evaluation.

A short-term training event entitled *"Considering gender dimension into sectoral planning in the context of the national climate change adaptation planning process"* dedicated to sectoral specialists, climate experts, gender focal points of central public institutions, environmental and gender NGOs was carried out. The goal of the event was to bring to the attention of relevant stakeholders the importance of considering climate change through a gender perspective and mainstream gender equality in the development planning. The use of the gender screening techniques for gender mainstreaming into the existing policy documents and development plans as well as of the *ex-ante* gender mainstreaming into newly developed strategies and plans were the thematic areas of the practical group sessions of the training.

Another topic brought into discussion during the workshops was how to correctly communicate climate change adaptation and gender, using awareness raising and information events, publications, and other dissemination materials and media channels. Workshops and roundtables on *Gender-Responsive Policy Development* for sectors communicators of line ministries, journalists, representatives of National Bureau of Statistics, NGOs were held with the goal to familiarize participants with the concept of gender equality in the context of climate change adaptation. A specific attention was paid to building competency of decision makers to mainstream gender into sector development policies and correctly communicates climate change adaptation.

During the organized events the need was identified to develop tools and methodologies for assessing gender responsiveness and sensitivity of programs and policies. Responding to stakeholders' request, the methodological support was provided to technical planners on a sector- based guidance. Guiding materials on gender incorporation from climate change perspectives into development planning of energy[223], transport[224] health[225], forestry[226], and other sectors were developed and published (Fig. 6-25). Additional awareness raising and information leaflets on gender and climate change adaptation as one of the key determinants of sectors' vulnerability to climate change were produced by the national experts on gender. For the reason of widening gender and climate audience, the leaflets on adaptation related gender-differentiated roles in different sectors were published both in Romanian and Russian languages.

[223] Bodrug-Lungu V. Ghid privind includerea dimesniunii de gen in domeniul energetic in contextual schimbarilor climatice. Chisinau, 2015,15 p.

[224] Bodrug-Lungu V. Ghid privind includerea dimesniunii de gen in domeniul transport in contextual schimbarilor climatice. Chisinau, 2015,18 p.

[225] Bodrug-Lungu V. Ghid privind includerea dimesniunii de gen in domeniul sanatate in contextual schimbarilor climatice, 2015, 15 p.

[226] Bodrug-Lungu V. Ghid privind includerea dimesniunii de gen in domeniul silviculturi i in contextual schimbarilor climatice. Chisinau, 2015,19 p.

Figure 6-25: Publications on gender dimension in climate change planning available for on-line and in hard copies for technical planners and general public.

Unsustainable subsistence agriculture forces outmigration of men from the rural areas that are affected the most by extreme weather conditions, women are left behind to perform unilaterally all the household duties at the expense of their childcare duty (34% of households in the Republic of Moldova are female-headed). This negatively impacts their families and the social capital of the community. These gender aspects have been highly considered within DRCMP WB Project. More climate resilient agriculture could potentially reduce outmigration from rural areas. According to the WB Moldova: Gender Disparities in Endowments and Access to Economic Opportunities (2014), 24% of employed women in the Republic of Moldova work in agricultural sector and 14% of the businesses owned by women are concentrated in the food sector. To this end, improved resilience of the agricultural sector positively affects livelihoods of both women employed in agriculture and those running businesses related to food processing.

During the training workshop "*Strategic communication in promoting the development projects in Moldova*" organized by MoEn, jointly with CO UNDP and the State Chancellery of the Republic of Moldova a whole day training on gender and climate change topic was delivered to 45 sector level communicators. The importance of communicating climate change adaptation through gender lenses and different adaptation needs of women, men and vulnerable group was the main focus of discussion held during the 2-days of the works.

ADA/UNDP Project organized a public event to debate the issue of gender and climate with the involvement of civil society representatives. One of the objectives of "*Challenges and opportunities of climate change from gender perspective*" event was to involve more youth in the thematic discussion and debates; therefore, *Tucano* café, a location popular among students was chosen for the event. The main gender message brought to participants focused on the analysis of various situations, including climate conditions along with men and women's understanding of the impact of various legislative practices, cultural policies and programs on women and men and their relevant adjustment in the context of climate change. The event was supported by the PIU of the project, national experts on gender and adaptation, NGO representatives. The debates were highly interactive, applying role games on various aspect of gender – climate thematic. The main concluding remark of the participants was to continue the debates or other forms of interaction with youth representatives on gender-climate topic (Fig. 6-26).

Figure 6-26: Awareness raising and capacity building events on incorporating gender dimension into climate change adaptation planning and implementation.

The success story "*Women leading the way to climate-resilience in Moldova*" with posting on national and UNDP media platforms emphasized the role of women-entrepreneurs at the local level and could be seen as a source for replication of the best practices. Through the project's dedicated grant scheme to showcase innovative adaptation measures at the local level, money has been set aside to ensure that women have access to the training they need. As part of these efforts, the pilot project "Green energy for entrepreneurship activities" led by a woman, offered consulting and support to individuals on how to manage resources, fundraise, etc.

The representatives of NGOs active in gender/women issues were active participants and promoters of gender equality in various organized awareness raising, information and dissemination events: PA *Gender-Centru*, *The Honour and Right of the Contemporary Women*, *Association of Women Partnership for Development*, *Ecological Movement of Moldova*.

National experts on gender and adaptation have participated in dedicated radio broadcasting events on gender and climate issues - Radio Moldova "*Spatiul Public*", *Radio Moldova Tineret*, *Media Centre for Youth*, *Publika* TV.

6.3.6. Prioritizing and appraising of adaptation options

During the planning and implementation of adaptation action, the consultative prioritization process has been conducted for different purposes: sectors' prioritization as key sectors for climate change adaptation consideration at country level, for developing sector specific policy documents and mainstreaming climate change adaptation into development policies, prioritization of adaptation options for further formulation as adaptation measures to be implemented according to the Action Plan of NCCAS, adaptation technology prioritization during the development of Technology Action Plans (TAPs), adaptation measures prioritization to be implemented at the local level, etc. Based on the various monetary, social and environmental criteria, the assessments indicated the priorities for a specific timeframe according to available resources. Alternative options were considered to meet specific adaptation targets.

Stakeholder engagements in prioritisation process was crucial and included wide sector consultations, in particular through the workshops to discuss the rationale, benefits and procedure for mainstreaming adaptation into a national, sectorial or local strategy, planning document or process.

In order to come to a robust decision, the stakeholders participating in those exercises considered various scenarios and uncertainty generated by the changes in the climate combined with those of economic development of the country. This approach was extensively applied in the Republic of Moldova's Technology Needs Assessment (TNA) and development of Technology Action Plans (TAPs) for various sectors. Sectors prioritization was based on: a) data from the previous national and sector vulnerability assessments that showed vulnerabilities to climate change of each sector and at country level; b) the adaptation potential of the sectors; c) how the improvements (potentially implemented technologies) in the selected sectors can contribute to achieving country's development priorities.

A number of guidelines (*UNDP TNA Handbook*[227], *Multi-Criteria Analysis Manual*[228] *MCA Guidance for Adaptation Technologies*[229] have been applied in prioritisation exercises. During the technology appraisal, each sector working group led by a team leader applied the main 8 steps of MCDA, and establishing the decisional context in technology prioritization was an important one along with broader objectives of the analysis. Stakeholders from governmental institutions, NGOs and private sectors, national consultants participated in the development of national criteria and their components (set of indicators) used in technological appraising. Each technology was evaluated against each of the criteria and consensus built around a particular score for each technology on the respective criterion. Disagreements were analysed by carrying out sensitivity analysis with different scores. Based on undertaken MCDA analysis sectoral technologies have been prioritized for agriculture and health sectors. For each prioritized technology a Technology Action Plan was developed and recommended to the sector for its implementation.

Multi Criteria Analysis (MCA) methodology was used in the sectoral Institutional Capacity Assessment and during the Capacity Development Plan, involving multiple stakeholders approach and experience, experts perspectives and expertise, generating and sharing of understanding, allowing negotiation within participants, and supporting a participatory group decision-making process. Participants account for different types of knowledge in the area of climate change adaptation, ensure transparency of each step of the appraisal process, have a strong element of stakeholders' engagement. In sectors' prioritization the assessment criteria were formulated in terms of three underlying components: (1) overall impact on Moldova's ability to adapt to climate change; (2) degree of sectoral need; and (3) underlying functional capacity to address climate change as identified in the Institutional Capacity Assessment. These components were integrated into a two-dimensional matrix that served to reflect seven sector impact and need measures and twelve readiness and interest strength measures. This approach allowed an interpretation of the final score based on: (i) relevance of difference in the indicator value between different sectors; (ii) best possible value; and (iii) worst possible value.

At the *local level*, the prioritization process was applied for prioritizing the *sectors and thematic areas* for implementing innovative adaptation options/technologies. Selection of the most vulnerable districts with the highest degree of vulnerability to climate changes was conducted according to the *Livelihood Vulnerability Index (LVI)*, which is based on the sustainable existence concept and incorporates major components, like: social-demographic profile, water supply, environment, financial support, climate variability, frequency of natural hazards and others.

The prioritization of sectors for each Development Region of Moldova to implement adaptation technologies was

[227] UNFCCC/UNDP. Technology Needs Assessment for Climate Change. Handbook, 2010
[228] Multi-criteria analysis: a manual. 2009. Department for Communities and Local Government, UK. -165p.
[229] Evaluating and prioritizing technologies for adaptation to climate change. UNEP DTU partnership, 2015, 32 p.

based on ranking the vulnerability degree in a hierarchic list and following the MCA. Subsequently, the validation of these sectors as priority sectors for the implementation of adaptation measures to climate changes was done within a transparent consultative process at the level of administrative-territorial districts identified as the most vulnerable. The validation process allowed the prioritization of other sectors, either through the multi-criteria method, or through sensitivity analysis, involving the administrative reasoning of some priority needs, as well as the expression of the level of interest of beneficiaries applying sensitivity analysis.

Appraising and prioritisation of adaptation options was a key step in climate change adaptation planning, either mainstreamed into existing policy or part of newly developed strategy or planning document, it was important to analyse exactly where the changes take place and who makes these changes. The results had to be prioritized and appraised according to entry point scope (national, sectoral and local), based on selection criteria and agreed process of prioritization. The prioritization process was used also to ensure overall consistency between sector priorities and the overall national adaptation approach, as well as to identify sectors with a high level of need and willingness to develop the sector's capacities in relation to climate change adaptation.

Prioritization of adaptation measures considering specific intervention level was an exercise supporting the formulation of strategy's action plan, referring to the time scale, scope, relevant stakeholders, and responsible leading agency. After the vulnerability of specific sector to climate change was analysed, identified adaptation options were appraised and prioritised.

The success of adaptation prioritization effort depended on the extent to which stakeholders have been engaged to participate in, inform and be informed on how climate change impacts development and vice versa. The information on climate change impact on sector was fundamental in prioritizing the adaptation options. Stakeholder groups included many different actors, such as from sectoral ministries, government agencies, academic or research institutions, private sector and the LPA that have different knowledge, and viewpoints in various areas of adaptation. During the identification of adaptation options and their appraising, of particular importance was the involvement of actors and experts with broad knowledge in applicable areas of adaptation.

From a methodological perspective, in the prioritization of the adaptation options the dedicated chapter of the *Mainstreaming Climate Change Adaptation into Moldova's Policy and Planning*[230] Guide provides a six-step approach to undertake adaptation options prioritization (Fig. 6-27): (1) specify drivers (criteria) of each dimension; (2) assign relative importance weights to each of the drivers to map qualitative criteria into a quantitative scale. This occurred in a participatory manner through elicitation of expert and sectorial representative input at public workshop; (3) score each sector against each driver; (4) normalize scores to provide the utility value attached to each driver through the identified functional capacities; (5) use local convergence analysis of iterative aggregation to determine the relative value of each criterion to each sector; and (6) perform a sensitivity analysis to determine the unique score that will be used to compare the sectors.

[230] Yovel E., Santos S. Mainstreaming Climate Change Adaptation into Moldova's Policy and Planning. ADA/UNDP Project, Chisinau, 2016

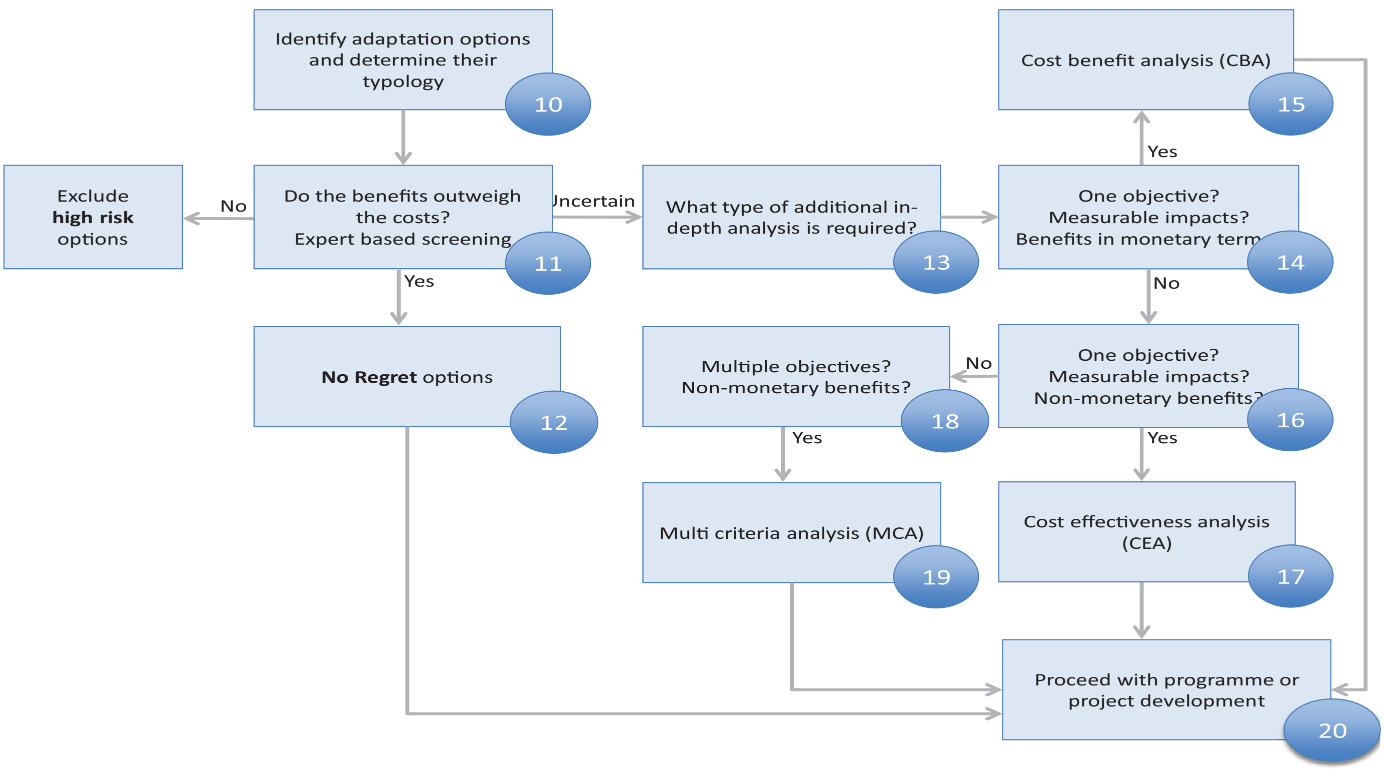


Figure 6-27: Climate screening flowchart (Part B): prioritization of adaptation options[231].

[231] Yovel E., Santos S. Mainstreaming Climate Change Adaptation into Moldova's Policy and Planning. ADA/UNDP Project, Chisinau, 2016

Sector's interest and engagement to address CCA was expressed during the consultation process, the two sectors *health and forestry* have expressed their willingness and readiness to develop *sector-specific Climate Change Adaptation Strategies* and their implementation *Action Plans* as standalone documents, while other sectors *agriculture, energy, transport* expressed their willingness of having CCA mainstreamed into existing sectoral policies and development plans.

The prioritisation of adaptation measures/technologies included an economic assessment of the efficiency of proposed adaptation measures, based on the *cost-benefit analysis (CBA) and MCDA as* analytical tools that supported decision-making on the most adequate options for adaptation measures. A methodological *Guide*[232] *on applying the cost-benefit analysis* of adaptation options for prioritisation of adaptation measures at sector level and for climate-proof investments was developed. The objective of this guidance was to direct consultants, decision makers and technical experts on how to facilitate discussions for prioritizing adaptation measures/technologies, and to support the stakeholders in identifying appropriate economic criteria for this analysis. The Guide emphasised the experience of applying the CBA in decision making of appraising the alternative adaptation measures of transport, energy and agriculture sectors proposed for mainstreaming into sectoral development planning. During the appraising of adaptation measures, sectoral planners and technical experts considered many financial components and elements, in particular economic and social returns on the investments.

In addition to the above-mentioned approaches in adaptation prioritization, the *Climate Budgeting Tagging* system (CBT) is seen as a tool helping Moldovan Government to prioritize and allocate financial resources to activities presenting climate change benefits in addition to their regular economic, social and environmental benefits. Implementation of a CBT approach allows the development of a system for tracking, monitoring, and reporting of climate related expenditures without a major overhaul of the existing system. The CBT system is implemented through adding budget codes to identify and report the proportion of government expenditure allocated and spent to implement climate adaptation and mitigation actions to complement the monitoring, evaluation and reporting system of the NAP.

The prioritization of adaptation options/measures based on SAP and NAP approach is described in the sub-chapter 6.4.1

6.4. Climate change adaptation coordination, monitoring and evaluation

6.4.1. Cross-sectorial climate change adaptation coordination mechanism

One of the main findings of the Institutional Capacity Assessment was that the required institutional capacity to effectively address the impacts of climate change needs to be strengthened, particularly in relation to the types and extent of participation by actors and stakeholders across different sectors and levels.

The integration of adaptation into government and governance across sectors is considered critical to long-term climate resilience and adaptation. During the consultation process with regard to Moldova's adaptation planning process undertaken through a number of public events (workshops, roundtables, meetings), participating stakeholders, in particular decision factors, expressed their opinion that at the current stage of country's socio-economic development, the most appropriate approach in dealing with climate change vulnerabilities and adaptation would be sector- based. This approach was adopted during the development of country level *Climate Change Adaptation Strategy of Moldova (2014)* and its implementation *Action Plan*, therefore, further on, in adaptation planning process sector- based approach was the one prevailing.

At the same time, adequate consideration of coordination of cross-sectoral interactions among key climate-sensitive sectors such as water resources, agriculture, forestry, health, energy, and transport was identified as an emerging need. Typically, the planning process of Moldova uses a sectoral and activity based approach, with little consideration for cross sectoral interactions, while climate change brought multiple stresses in Moldova, sectors facing resources constrains, therefore, planning and implementation of adaptation require comprehensive and integrated approach with coordination between sectors and at different scales. Cross-sectoral coordination will help identify nexus opportunities, in particular between key sectors: water-food security-energy and understand their perspectives in country's adaptation to climate change. The need of a leading agency with influence across government and non-government organisations was identified as a modality to ensure coordination of planning actions at multiple levels of governance and support building up of an integrated adaptation planning process and help driving effective action across sectors and ministries. Despite that sector-based approach is perceived as the main one, other approaches: sub-sectoral, district, community levels have been integrated and applied during the planning and implementation of adaptation action.

Meeting these needs and requirements and addressing future climate challenges in a systematic way, the concept of *Climate Change Adaptation Coordination Mechanism (CCACM)* as a cross-sectoral multi-stakeholder mechanism to maintain a sustainable institutional arrangement for climate change adaptation in Moldova chaired by the *National Commission on Climate Change (NCCC)* with the mandate to coordinate adaptation planning and action among all government entities, to monitor progress on adaptation, to facilitate the implementation of enabling activities for capacity development and to oversee the distribution of resources for adaptation action was developed and discussed with stakeholders. The mandate for creating an adaptation coordinating mechanism stems from the *Climate Change Adaptation Strategy of the Republic of Moldova*, which includes actions to strengthen appropriate institutional mechanisms and reinforced and operationalized through a dedicated Government Decision currently undergoing approval process. The concept of CCACM was supportive to an already existing climate coordination body that assisted in reducing the administrative burden for participants, reduce the potential for duplication and build on existing collaborative arrangements. The *National Commission for implementing the commitments under the UNFCCC and the Kyoto Protocol*

[232] Baltag Grigore, Applying the cost-benefit analysis to evaluate sectoral climate change adaptation measures

2003 focused on mitigation actions, encompassed adaptation component and transformed into the *National Commission on Climate Change (NCCC)*. The commission is an independent body which advices the Government of Moldova on tackling and preparing for climate change as well as reporting on progress in various areas of climate change. The NCCC is seen as a permanent formalized body with highest representation of key stakeholders: sectoral ministries, NGOs, academia, research, private sectors, taking into consideration gender dimension through including representatives of women associations and considering gender equality in all supervising activities of NCCC (Fig. 6-28).

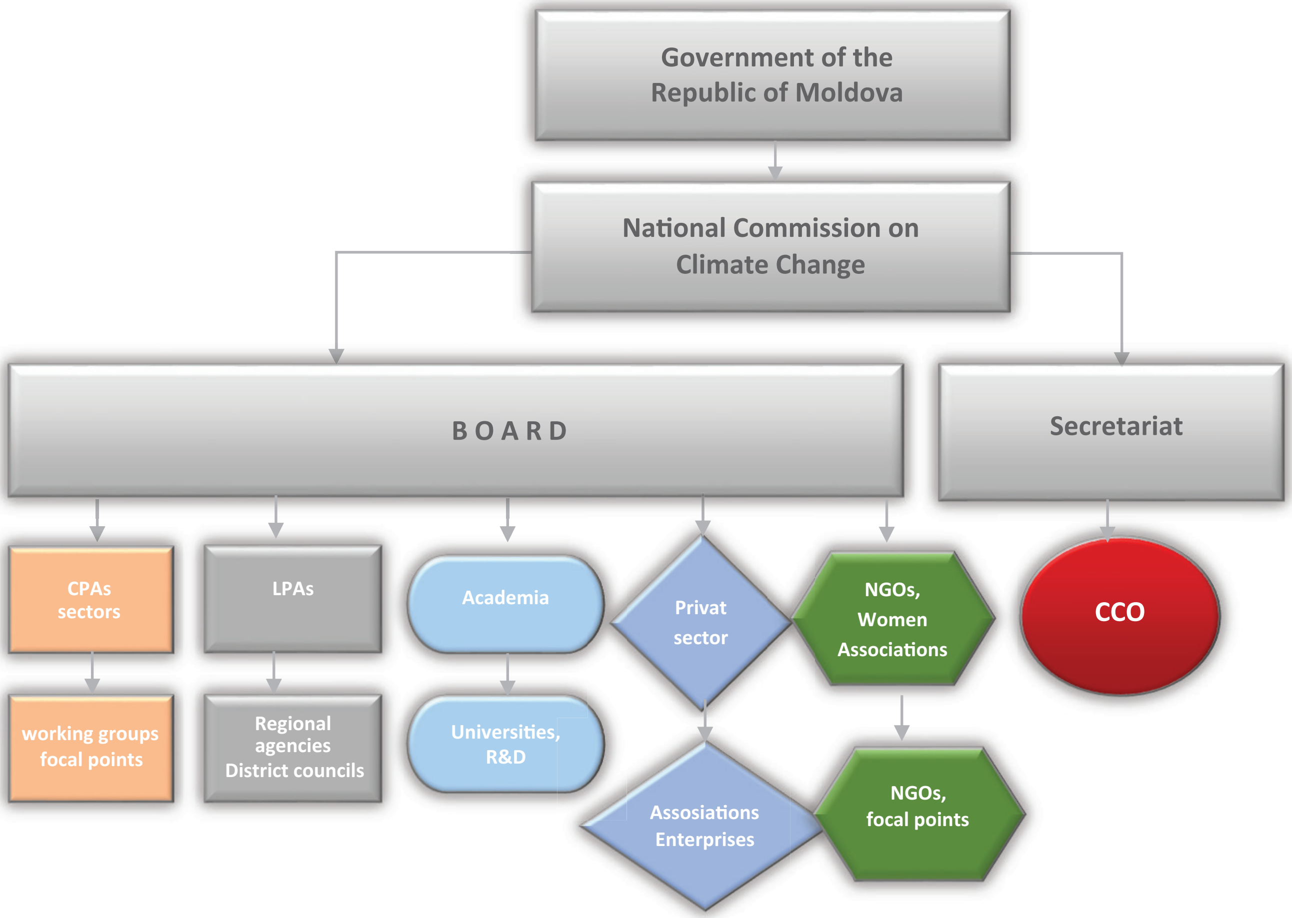


Figure 6-28: The structure of the National Commission on Climate Change that leads the Cross-Sectoral, Multi-Stakeholder Adaptation Coordination Mechanism of Moldova.

Such organizational structure of NCCC comprises actors of horizontal, inter-sectorial planning and of vertical integration, with the representation of below sectoral/national level, thus ensuring a multi-level framework with interactions between government and civil society representatives. The NCCC will have a Secretariat as a technical executive body and Climate Change Office (CCO) under the Ministry of Agriculture, Regional Development and Environment is a legitimate and credible body that will provide staff of sufficient professionalism in the area. At the sector level, the NCC Commission will be supported by the sectoral administration in charge with development of sector specific climate change adaptation enabling environment and reporting on adaptation action forming working groups or nominating focal points. Technical committees on specific thematic areas will be formed ad hock when the need in advanced thematic expertise will be required through recruitment of experts.

Through proposed structure and composition of CCACM, the Republic of Moldova overcomes the issue of limited integrations and connectivity between levels, which is an impediment to effective interaction in adaptation and supports national adaptation decision-making process.

The *purpose* of the multi-stakeholder adaptation coordination mechanism is to foster dialogue, coordination, collaboration and coherence among sectors, leverage and report on planning and actions by all stakeholders related to climate change adaptation in the country. The established multi-stakeholder partnerships is foreseen to contribute to the development of common understanding in adaptation panning, improved rationality and effectiveness of policy making, facilitate the implementation of adaptation action, have contribution in sustainability of governance. Cross-sectoral coordination will enhance also transparency in implementation of adaptation measures and avoid maladaptation.

As the NCCC coordinates all 3 components referring to climate change: GHG emissions, mitigation and adaptation, the roles and responsibilities of the NCCC with regard to adaptation component have been developed and formalized in the same dedicated Government Decision that will enact cross-cutting adaptation coordination. Enacting of the GD ensures a fully operational Coordination Mechanism with clear roles and responsibilities established as part of the national adaptation planning process. The Climate Change Adaptation Coordinating Mechanism is placed under the leadership of the Ministry of Agriculture, Regional Development and Environment, chairing the NCCC and it is tasked with: a) coordination of actions to implement climate change adaptation; b)coordination of sectoral plans on adaptation; c) monitoring of sectoral efforts to integrate adaptation into planning (mainstreaming); d) gender mainstreaming of climate change policies; e) the development/revision /update and implementation of regular NAPs; f) the development and implementation of monitoring and evaluation frameworks for adaptation; g) the creation of partnerships for adaptation nationally and internationally; h) the mobilization of resources and/or the monitoring of (national and international) resource allocations for adaptation; i) giving of accounts to the Government of Moldova on adaptation progress.

Republic of Moldova in its efforts to establish an integrated National Adaptation Planning (NAP) process at national level and Sectoral Adaptation Planning process (SAP) at sectoral level has aligned the functionality of the CCACM to planning cycle of NAPs and SAPs. Therefore, following from the GD, each ministry responsible for a sector is in charge to develop a dedicated sector specific adaptation enabling environment for adaptation action every four years (in line with country regular planning cycles), or to integrate adaptation planning and action into existing sectoral development planning. Both approaches will lead to formulation of a Sectoral Adaptation Plans. Prior to their approval at sector and national levels, the SAPs are consulted with NCCC in order to ensure their alignment with the *Climate Change Adaptation Strategy*, *NDCs* and *SDGs*. As a result of the consultation, the NCCC shall issue its opinion, summarizing all members' viewpoints along with those of experts from the relevant (thematic) technical committees, and, where appropriate, recommendations for improvement shall be given.

Sectoral Adaptation Plans identify a set of priority adaptation actions to be implemented on a rolling basis. Actions included in these plans are developed in response to the different impact that climate change may have on the sector and on various social groups. The prioritization of adaptation measures is done by the sectors or stakeholders participating in the development and implementation of NAPs and SAPs. Each time a SAP or a NAP will be proposed, it should contain prioritized measures for that planning period. The process of determining the prioritization and selection of certain adaptation options over others should be transparent and based on rationalized criteria. The prioritization exercises could be carried out by a stakeholders group, which can weigh in considerations from different economic, environmental, social, cultural or political spheres and concerns. Cost Benefit Analysis (CBA), Cost Effectiveness Analysis (CEA), Multi Criteria Decision Analysis (MCDA) and other relevant to case econometric assessment methods and tools are applied during the prioritization of adaptation measures. At the end of the planning period, each ministry will report on its actions to NCCC (see M&E component).

The same Government Decision enforces the NAP/SAP approach in adaptation planning therefore, CCACM foreseen to act based on NAP process cycle will ensure linkages between sectoral/national and sub-national adaptation planning and implementation. The plans would have to be implemented from existing domestic resources and based on accessed external support.

Activities common to all sectors, for example, assessments, capacity development, technology, research, publications, consultations, reporting are part of cross-sectoral actions within NAP. These activities are considered as enabling/supporting activities for the sectoral plans. That plan would be updated every 4 years, based on progress in implementation. The NAP would also be developed in a socially and gender-sensitive manner.

The Government of the Republic of Moldova is currently undertaking institutional reforms that will promote a stronger linkage between institutions within CCCM.

6.4.2. Climate change adaptation monitoring and evaluation system

6.4.2.1. Scope and purpose of adaptation M&E framework

Along with cross-sectoral coordination of adaptation action, comes the need to monitor and evaluate the effectiveness of developed polices, implemented measures, vulnerability and adaptation of natural and socio-economic systems, financial and human resources, along with transparency of process and data collection, other adaptation related work, therefore, the concept on the system/framework for Monitoring and Evaluation (M&E) with regard to adaptation component was developed and tailored to specific circumstances of Moldova's adaptation planning and implementation. The proposed framework addresses the issues of monitoring, reporting and evaluation of adaptation, overcoming the barriers and constraints with respect to the development of adaptation indicators.

The *system of interest* for Moldova adaptation M&E framework includes agriculture, water, health, forestry, transport, and energy sectors considered as priority sectors in country's adaptation process due to their high impact of climate change.

Though the NAP process in Moldova is underway and is not completely formalized, the M&E system to assess and track progress under the successive NAPs/SAPs is under development and follows the phases mentioned in the Fig. 6-29.

The system serves as basis to plan future iterations of each plan based on sectoral approach and the institutional set up for coordinating adaptation planning. Such a system is necessary owing to the fact that adaptation is considered an iterative process, one which is expected to progress over time and the responsibility for implementing adaptation actions will be spread between sectoral actors. There is a need to ensure that actions are geared towards a common adaptation goal established for each NAP and monitored through the M&E system. M&E monitoring at sectoral and national levels is aligned with national priorities and catalyses national level learning for further planning and is gender-sensitive in its composition and activities. The precise definition and methodology for measuring progress on specific level indicators, as well as capacity building and training of individual sectoral stakeholders for monitoring of other indicators are under development.

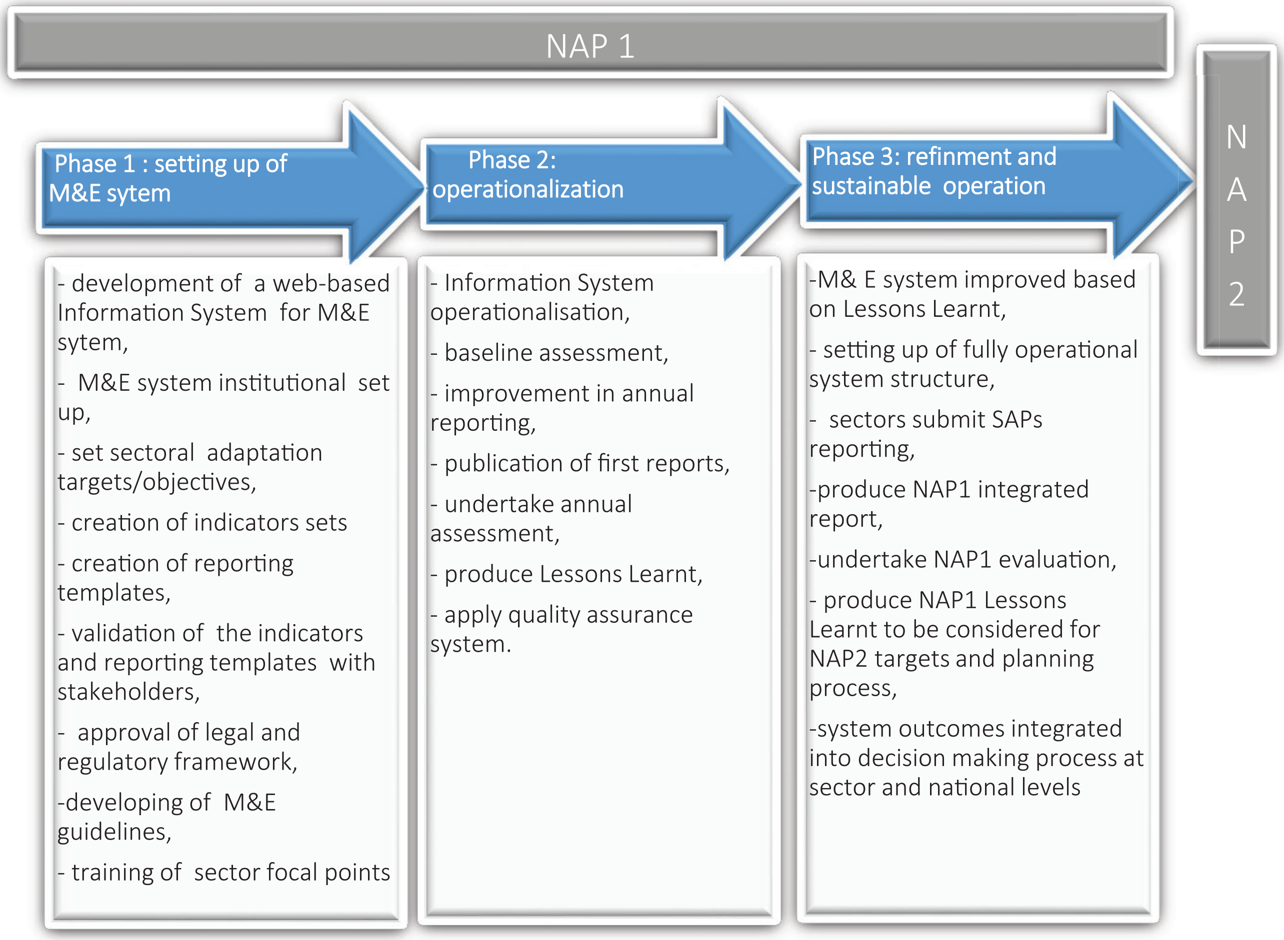


Figure 6-29: Phased activities to setting up of M&E framework in the Republic of Moldova.

The M&E system for Moldova's adaptation component will serve the following purposes:

- create a set of overarching adaptation goals to which each sector will contribute,
- track and monitor individual sectoral objectives and indicators,
- allow for iterative planning and continuous, evidence-based adaptation planning,
- enforce the gradual integration of adaptation priorities in regular development planning,
- ensure transparency of adaptation process and data collection,
- measure and monitor the outcomes and impacts of adaptation activities, investments, programmes on women and men's resilience to climate change from gender-responsive perspective.

The M&E system incorporates also *communication and knowledge management component* that helps raise awareness and disseminate public information about the most effective adaptation strategies and about the means to mainstream climate change issues into development plans, other knowledge related information.

Ultimately, the goal of the M&E system is to *ensure the measurability of progress across geographic scales, time and sectors, and to be able to determine whether, as a result of its successive plans, Moldova is less vulnerable to the impacts of climate change.*

6.4.2.2. M&E institutional setup and the monitoring process

The M&E will operate as part of the overall cross-sectoral Climate Change Coordination Mechanism (CCCM) specifying sector level as the main one in monitoring of adaptation planning and implementation.

The National Commission on Climate Change (NCCC) of Moldova with representation of line Ministries in its composition, including its Secretariat will be the responsible entity in charge with national monitoring, reporting and evaluation procedure. The Secretariat will be tasked with collecting and integrating information on climate change implementation across sectors and producing reports according to the stage of NAPs implementation. Upon completion of each NAP, based on M&E system data, the NCCC and its Secretariat will produce an overall NAP report.

Upon approval of GD, the NCCC will monitor:

- progress and evaluate impacts of implemented policies,
- implementation of adaptation related planning,
- development and dissemination of adaptation related knowledge and research, including guiding material, methodology, tools and instruments
- implementation of adaptation technologies and practices,
- adaptation related financing and investments, including adaptation-related external support received,
- adaptation related quality assurance process.

Line Ministries will collect and report sector-specific data along with cross-sectoral information. Each sector assigns a working group led by an *adaptation focal point* or *M&E focal point*, whose responsibility is to track progress across the selected indicators. The focal points have the responsibility of collecting information from the sector, providing required syntheses, and participating in any cross-sectoral monitoring and reporting activities under the aegis of the NCCC.

Adaptation being a context–specific process, its monitoring, reporting and evaluation components have to take into account sectoral objectives and priorities, therefore, prioritization of adaptation areas and measures for each sector are of high consideration within M&E system.

The proposed Monitoring & Evaluation framework is based on the need to monitor progress towards achieving resilient economic growth, as noted above. Using a sectoral planning approach aligned to NAP approach to adaptation, this requires monitoring of sector-based activity as well as their aggregate impact on the overall country economy and further communication of adaptation state at sector and national levels (Fig. 6-30).

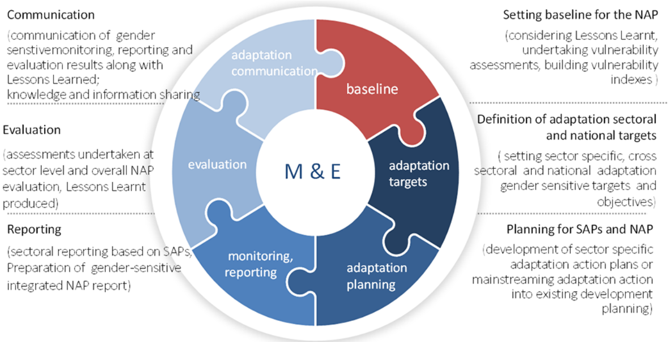


Figure 6-30: Monitoring and Evaluation Framework Components of Climate Change Adaptation in the Republic of Moldova.

The proposed M&E framework would allow for monitoring and planning along a 3-tier approach (Fig. 6-31):

- *Micro-level monitoring* is targeted at assessing the adaptation result of individual actions (i.e. at the output level). This monitoring is akin to project level M&E, with distinct, time-bound gender-sensitive targets closely tied to direct actions. These indicators would be based on the specific actions, included in each sectoral action plan, and would therefore, change from one cycle to the next based on NAP planning.

A micro-level reporting will also be devised by each sector. This level of reporting will be internal to each ministry's own action plan and will be used to track the effectiveness of individual adaptation actions. As such, communication of data gathered on that level is not mandatory; however, data gathered at the level of individual adaptation actions can be used to fulfill the reporting requirements of the other two levels.

Each of these indicators are attached to actions contained in the specific sectoral or sub-sectoral action plans. As such, they serve as the basis level of results tracking by stakeholders, and would be subject to each ministry's own reporting mechanisms. They could be modified at each round of successive planning, and be aggregated to feed into the meso- and macro-level reporting frameworks.

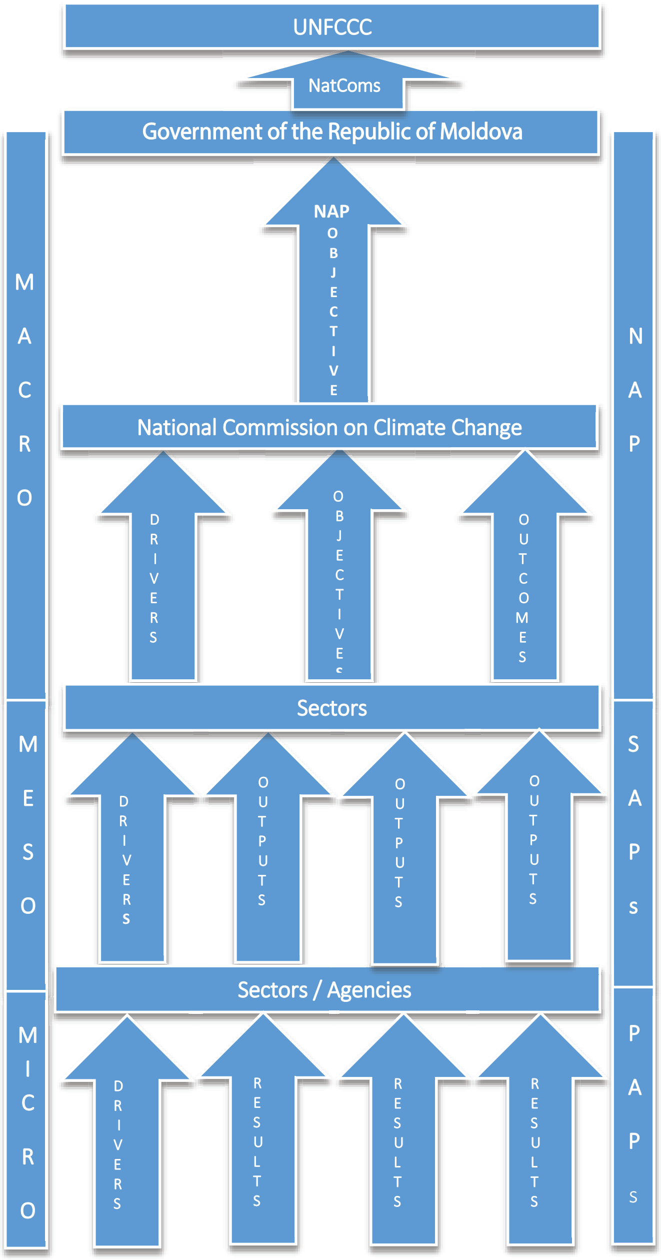


Figure 6-31: Levels of indicator based reporting (macro, meso, micro) of PAPs (programs, activities, projects), SAPs (sectoral adaptation plans and NAPs (national adaptation plans).

- *Meso-level monitoring* allows for the tracking of adaptation achievements at the outcome level.

Based on aggregation of sector-level information, this level allows for tracking the efficiency of the adaptation planning process, and the extent to which sectoral vulnerabilities have been reduced. This level of monitoring also allows for tracking of the enabling conditions for adaptation planning. Meso-level monitoring allows for tracking of progress and results at a disaggregated level, collecting gender disaggregated data, in this case using a sectoral approach, but with a potential to be decentralized at territorial (regional) level. This level also allows for evaluating the effectiveness of the adaptation planning process in itself. The key assumption here is that a sound adaptation process ultimately leads to increase in resilience. This requires the development of a process-oriented indicator that will help monitor the extent to which adaptation has been integrated into the development planning processes.

Information should be gathered by the adaptation focal point in each ministry. Also, while these indicators remain somewhat process-oriented, each sector, during the NAP is allowed to adopt its own concrete adaptation indicators. Sector-specific indicators are to be agreed upon through the NCCC during the early phases of NAP and SAP planning, and could be renewed, depending on their relevance, at the end of each planning period.

- *Macro-level monitoring* is conceived to evaluate or periodically assess the global, cumulative

Impact of all sectoral adaptation actions. The key indicators in this group are therefore designed to measure the extent to which the country economy is resilient or, conversely, the degree to which it remains vulnerable to the impacts of climate change.

These indicators will be measured through a participatory multi-sectoral process in which each sector determines the degree of experienced negative impact over a given reporting period. The assessment will be based on a combination of expert judgment, economic analyses, and best available methodologies for sectoral impact assessment as proposed by key research institutes.

The results of these assessments will then be aggregated into an overall, economy-wide evaluation of progress towards resilience. This will be completed by the Secretariat of the NCCC. Results will be submitted by the sectors yearly or every 2 years, and the global synthesis will be produced every 4 years, or at the end of each NAP period. A thorough assessment of the baseline values for these two indicators will be computed during the first cycle of NAP (NAP1), as a cross-cutting enabling activity. This will provide the benchmark against which any future progress would be assessed.

The theory of change was applied to show how development and use of the framework could lead to more effective adaptation investments for climate resilient development, how an identified interventions is expected to achieve impact. Climate change has direct and indirect impacts on the Moldovan economy and the well-being of its people, for example on natural resource based economic sectors, such as agriculture and forestry, as well on health. Changing climate conditions also have direct and indirect impacts on other fundamental sectors such as energy, transport, or industry. This means that, in order to be considered resilient, the Moldovan economy must rely on the growth and resilience of economy sectors. In practice, this means that each sector must adopt its own measures through a sector specific adaptation strategy or plan or through mainstreaming climate adaptation into existing development strategy.

In order to better monitor progress on adaptation, an economy-wide definition of resilience, as well as sector-based resilience indicators, was designed during the development of national adaptation planning process. The following definition of resilience, appropriate to the Moldovan context and aligned to the national development objective of "ensuring qualitative economic development and, implicitly, poverty reduction"[233] was proposed:

"*A resilient Moldova is one in which economic growth and poverty reduction are not negatively impacted or restricted by climate variability and climate change*".

[233] National Development Strategy "Moldova 2020".

This constitutes the overarching objective of the current national adaption planning for Moldova, or the ultimate adaptation goal. However, a series of intermediate results are envisaged to achieve this goal, mostly related to sectoral resilience.

6.4.2.3. Reporting procedure

According to the Government Decision on Climate Change Coordination Mechanism and M&E (under approval), the reporting procedure will rely on indicator based system that will ensure regular reporting depending on the type of indicators. The main responsibility for data collection and reporting falls upon the sectoral administrators, who will need to undertake annual and biennial reporting for respective indicators.

The Government Decision stipulates the level of reporting based on indicators, with high responsibility at sector level. The data will be submitted to the National Commission on Climate Change, whose Secretariat will synthesize information to develop information notes and reports on adaptation implementation. The NCCC will also provide sectoral administrations with regularly updated templates, methodologies and formats in order to allow for standardized tracking.

Indicator-based reporting format at different levels consists of indicators for tracking and evaluating the success of adaptation support and adaptation interventions.

In the current setup for the adaptation process of Moldova, the three levels monitoring and reporting system is proposed, at the first, (bottom level of Fig. 6-32) are *drivers of change,* or *enabling conditions,* which are addressed through the successive NAPs, because of their cross-cutting nature. These indicators are gender-sensitive, monitoring gender-responsive activities in all sectors. At the second level, the implementation of adaptation actions is expected to lead to *short-term outputs* and *medium-term outcomes* all of which are expected to contribute to achievement of the overall goal. These two levels are included in the sectoral action plans (SAPs).

The M&E System should therefore be used to assess progress along each of these steps, as well as the aggregate impacts of these actions, leading up to the overarching goal.

The M&E system therefore includes 4 types of system –based indicators:

- *driver indicators*: Indicators designed to measure the result of actions targeting the drivers of change, for current stage they are identified to be: a) *there are resources mobilized for adaptation action, b) there is capacity to plan adaptation, c) there is deep knowledge on climate risks, impact, and vulnerabilities.*
- *output indicators:* Indicators designed to measure the result of adaptation actions included in SAPs.
- *outcome indicators:* Indicators designed to measure the result of SAPs in terms of reduced sectoral vulnerability and advancing in adaptation/resilience.
- *objective indicators:* Indicators designed to measure the aggregate result of a NAP cycle, in terms of impacts on the vulnerability of the Moldovan economy and progress in adaptation.

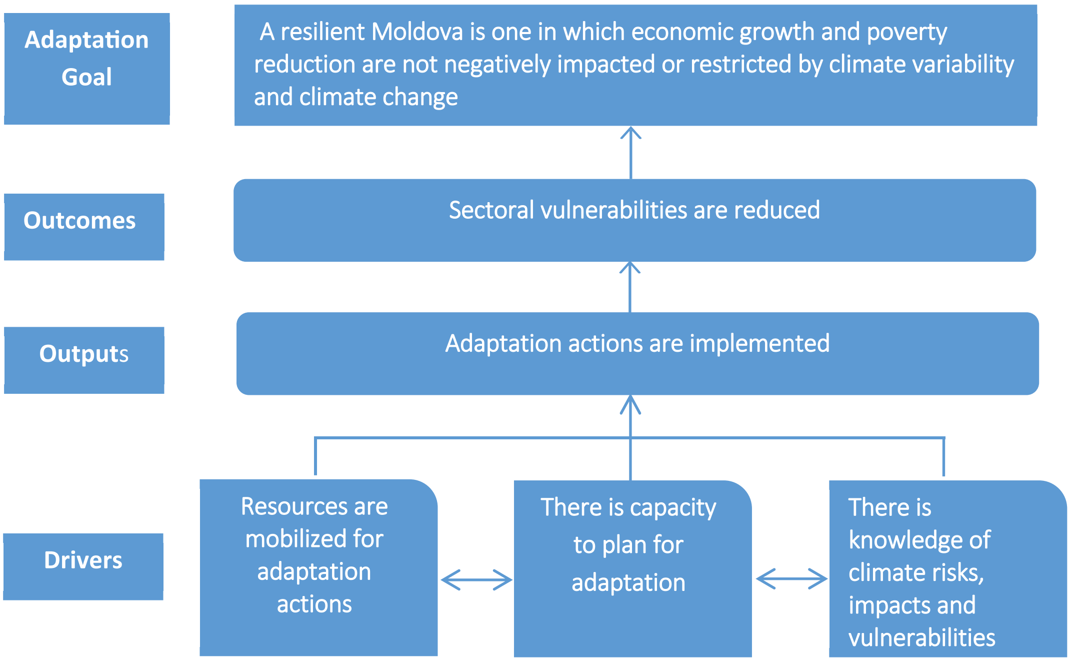


Figure 6-32: Theory of change applied for the Republic of Moldova's NAP Monitoring and Evaluation Framework.

a) Driver indicators measuring the drivers of change (Table 6-32). The indicators in this category are aimed at measuring progress in addressing some of the key structural constraints to adaptation and adaptation planning in Moldova.

Table 6-32: Driver Indicators and Means of Verification

Driver	Indicator	Means of Verification
Level of financial and human resources	% of national budget targeting adaptation-related actions	Setting up and operationalizing the CBT system where actions that are part of a SAP or NAP are tracked within the responsible ministries budgets and aggregated accordingly.
	Number of sectoral/regional planners allocated or involved in adaptation planning and action	Each ministry will be required to report on the number of people who have been designated as focal points or contributors to adaptation planning.
Level of capacity for adaptation planning	Level of institutional capacity for adaptation	This will be measured according to a capacity score card, using a self-assessment approach, by each sectoral ministry.
	Number of adaptation sectoral or regional plans in force	Each ministry will be required to confirm, whether it has a SAP in place, and whether this SAP is under effective implementation.
Level of knowledge of climate risks	Number of sectoral or economy-wide vulnerability assessments	Each ministry will be required to conduct periodical sectoral vulnerability assessments, and an economy-wide assessment should also be conducted every 4 years (1 planning phases), in order to allow for increased understanding of risks, integration of evolving climate information and scenarios, and upgraded methodologies.

Based on the work conducted during the Institutional Capacity Assessment undertaken in 38 institutions of 7 key sectors of Moldova and elaboration of Capacity Development Plan (2014-2015), three broad groups of interconnected drivers were identified:

1) the first driver is the *level of financial and human resources* available for adaptation planning and action at all levels. At a cross-cutting level, each NAP would be expected to facilitate the mobilization of financial resources for adaptation, as well as to facilitate the emergence of targeted human resources as well, for example through training. It is expected that each successive NAP will include measures designed to address this driver, but also that each SAP will include some form of action to mobilize resources.

2) the second driver is the *level of capacity to plan* for adaptation. As NAP cycles progress, it is also expected that this driver will be addressed as a matter of cross-cutting priority. While capacity includes individual capacity of planners (i.e. skills and knowledge), it also includes institutional and systemic issues, such as methodologies, access to information, legal and institutional mandates, organizational change, and the like. Here again, each NAP will address this driver in its cross-cutting nature, while each SAP will likely also include targeted actions within a given sector to address any constraints.

3) the third driver is the *knowledge of climate risks and vulnerabilities*, which in itself determines the scope of action required at all levels for achieving resilience. A broad level of knowledge and data currently exists to enable an assessment of vulnerability for each sector, but this is expected to evolve with successive planning phases. This driver creates the feedback loop that is required to make adaptation planning into an iterative process. As adaptation actions are implemented and approaches tested, increased or refined knowledge of vulnerability allows for planning at the next level, and so on.

Driver indicators will be the main type of indicators measuring the level of transformation change produced during a particular NAP. They will impact the change and have to be stronger than impact drivers that show changes which occur due to climate.

Indicators targeting these three drivers can be monitored at the sectoral level and at the national level.

b) Output indicators, activity-related reporting. This level of reporting is concerned with the direct, observable result of an adaptation action. Each ministry is tasked with developing an adaptation action plan, which will include a set of adaptation actions for the prescribed 4-year period. As with regular monitoring and evaluation, these actions will be subject to a performance assessment, to determine what they have achieved.

At the sector level, within SAPs targets are set and actions to reach them and indicators will be developed to track its immediate result. Examples of sectoral actions and related indicators are provided in the Table 6-33.

Table 6-33: Examples of Sectoral Actions and Related Indicators

Examples of adaptation actions	Indicators
Training of agricultural extension service members in c sustainable and resilient agriculture	Number of people trained, % of which are women
Improving the quality of drinkable water	Percent of population with access to quality drinkable water
Revision of road construction standards and regulations	Number of road construction regulations integrating adaptation concerns
Distribution of drip-irrigation kits to crop producers	Number of crop producers using drip-irrigation kits.

Each of these indicators should be attached to actions contained in the specific sectoral or sub-sectoral action plans. As such, they serve as the basis level of results tracking by stakeholders, and will be subject to each ministry's own reporting mechanisms. They can be modified at each round of successive planning, and be aggregated to feed into higher, NCCC level or results reporting.

c) Outcome level indicators: measuring sectoral vulnerability and adaptation. Outcome-level monitoring allows for tracking of progress and results at a more aggregated level, in this case using a sectoral approach, but with a potential to be decentralized at territorial (regional) level. The desired outcome is a reduction in the climate-related vulnerability of all sectors. Achieving this result requires the implementation of a set of adaptation actions, as well as the monitoring of risks posed by climate change on the sector.

It is expected that each planning phase will provide an incremental decrease in sectoral vulnerability as a result of implementing adaptation actions. However, the M&E system will also allow for qualitative assessments of this progress, so that barriers can be identified and addressed in future planning cycles. Indicators to support this level of reporting can be theme-based, meaning that they will proceed from a sector-specific theory of change. For example, water availability is a constraint to resilience for Moldova, then the water sector should adopt an indicator on water availability. This would therefore require each sector to first determine its own adaptation objectives within SAPs.

To allow for adequate tracking and aggregation of results, sector-specific indicators (Table 6-34) along with cross-sectorial indicators should be agreed upon through the NCCC during the early phases of NAP and SAP planning. They could be renewed, depending on their relevance, at the end of each planning period.

Table 6-34: Example of theme-based indicators

Theme-based indicators	Means of verification
Average crop yield for key products	Direct measurements of global harvest on main crops, from 1 ha of harvested area
Water consumption in agriculture	Based on the assessments of water used in agriculture production.
Percent of land under forest cover	Direct observation through forestry network and GIS/satellite imagery
Percent of energy from renewable sources	Direct observation through energy utilities

Objective indicators: measuring the rate of achievement of adaptation goals. The last level of monitoring concerns the measurement of whether Moldova's resilience has increased as a result of the NAPs and SAPs. While there is for now no comprehensive or recognized indicator of resilience, for Moldova will be measured both sectoral vulnerability (as a proxy for economy-wide vulnerability), as well as economic vulnerability.

The key indicators at the macro-level, are therefore designed to measure the extent to which the Moldovan economy is resilient or, conversely, the degree to which it remains vulnerable to the impacts of climate change (Table 6-35).

Table 6-35: Example of Objective Indicators used in the NAP

Objective-Level Indicators	Means of Verification
Extent to which economic growth and poverty reduction are negatively impacted or restricted by climate variability and climate change	Cross-sectoral self-assessment based on a rating system going from Low to Extremely High. Measured every four years through the NCCC.
Amount of economic impact due to climate change/variability.	Monetary value of losses, bi-annually. Or % GDP in losses, biannual. Wherever possible, data on GDP will be correlated to climate data.

A thorough assessment of the baseline values for these two indicators will be computed during the first NAP, as a cross-cutting enabling activity. This will provide the benchmark against which any future progress would be assessed. The CCCM may also establish targets for progress against these criteria. In the second and third years, individual sectors will collect data based on outputs, those that are based on the activities that are included in the sectoral plans. In the fourth year, sectors would provide data on outcome-level monitoring and on drivers, while the NCCC would launch a consultation to establish the assessment of the objective level indicators.

The micro-level reporting will be undertaken with the participation of local NGOs and associations who are participating in the implementation of targeted adaptation measures. Participation of NGOs at all levels of the M&E framework would also allow for increased transparency and for broader ownership and dissemination of results.

Developed indicator-based monitoring system will be operated through the *Climate Change Adaptation Information System* with a web site based portal (Fig. 6-33). The system contains:

- *A portal* (Fig. 6-34) intended for presenting public information related to the sectors of the national economy: policy documents stipulating adaptation targets, reports on vulnerability & adaptation assessments, publications, reports on evaluations, other materials. The portal extracts indicator public data of the monitoring component, assessed and evaluated by the experts using data collection and analysis templates for each indicator. Information is extracted to allow the presentation and search of indicators by field, thematic areas, level of development, data providers, calculation methodologies / formulas, spatial level, reference periods, frequency of data collection, expected adaptation trend and other monitoring and evaluation options.

- *A monitoring platform* designed to create, monitor and evaluate adaptation indicators by domains, focus area, level of development, data providers, calculation methodologies / formulas, spatial level, reference periods, frequency of data collection, expected adaptation trend and other options monitoring and evaluation based on templates. The platform allows managing expert access roles to the information collection templates. The data can be collected over reference periods and can be made public directly from the platform in the PORTAL component in the general module for the presentation and search of indicators as well as for each individual sector. Any indicator can be published in or hidden from the portal. For each reference year, the data collection form can be changed as needed.

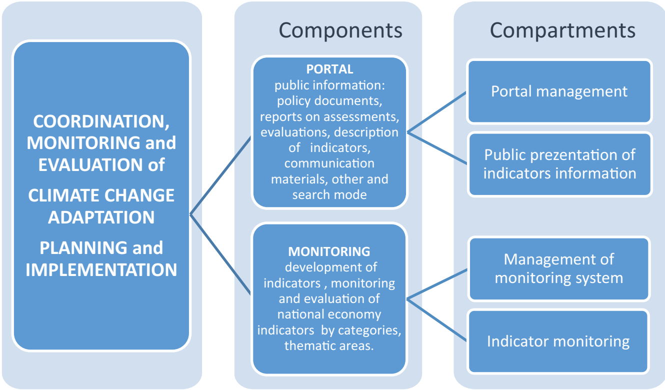


Figure 6-33: Climate Change Adaptation Coordination, Monitoring and Evaluation system Structured in two Components: WebPortal and Monitoring Platform.

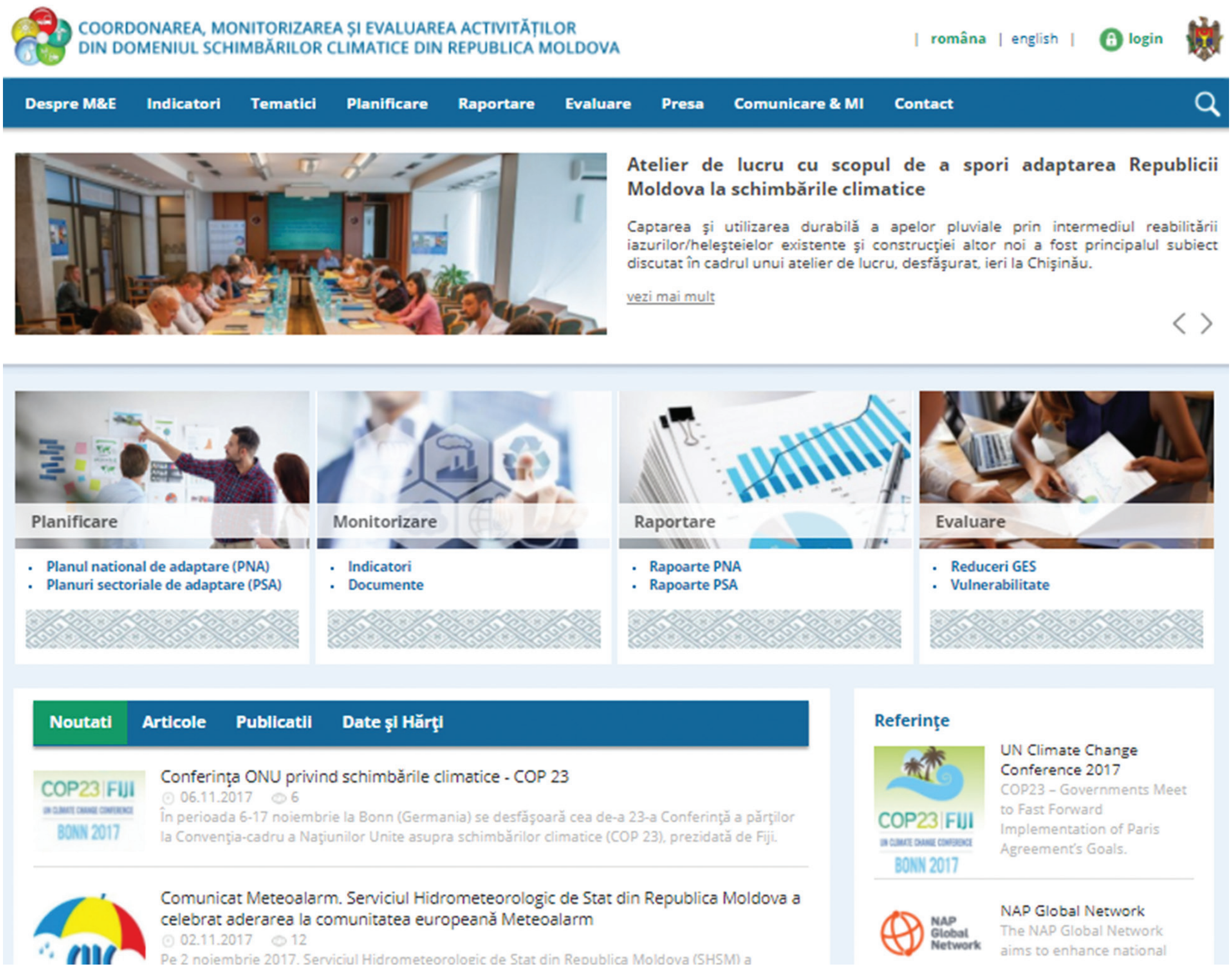


Figure 6-34: Website based portal of Climate Change Adaptation Information System.

The indicators have been designed to inform progress toward climate change adaptation according to above mentioned three level system and building climate resilience at the national and sub-national levels, they also reflect sectoral and national priorities within adaptation and sustainable development context. They consider social inclusion, geographical spread of adaptation efforts, are gender sensitive.

Indicator fiches contain specific information related to each indicator, category of indicator with regard to level of reporting along with their adaptation relevance: *impact, vulnerability, adaptation*, description purpose of indicator, affiliation to sector (*sector-specific, cross-sectoral*), data required, geographical coverage of indicator, units, measurement methods, sub-indicators (if needed), frequency of reporting, forecasted trend, link to reporting template (Fig. 6-35).

COORDONAREA, MONITORIZAREA ȘI EVALUAREA ACTIVITĂȚILOR DIN DOMENIUL SCHIMBĂRILOR CLIMATICE DIN REPUBLICA MOLDOVA

Prima | Planificare | Tematici | Indicatori | Evaluare | Managementul Informatiei | Contact

| Lista indicatorilor | Numărul inventarierilor impactului schimbărilor climatice asupra biodiversității, efectuate periodic

Pierderi de recolte în urma calamităților naturale: secetă, inundații, grindină 12 123

Descriere indicator: În Comunicarea Națională Trei a Republicii Moldova (2013) și Strategia de Adaptare la Schimbarea Climei a Republicii Moldova (2014) schimbările în frecvența și intensitatea fenomenelor extreme (cum ar fi seceta, inundațiile, ploile puternice și grindina) sunt identificate ca cea mai mare provocare pe care o înfruntă sectorul agricol ca urmare a schimbării climei. reductions in the future throughout Europe.

Fișa indicatorului

Cod indicator	**i0029**
Sectorul	**Agricultură**
Denumirea indicatorului	**Pierderi de recolte în urma calamităților naturale: secetă, inundații, grindină**
Tipul indicatorului	Sectorial de consecințe
Tematica indicatorului	Impacturi climatice
Relevanța pentru adaptare	**Producția vegetală** variază din an în an, fiind influențată semnificativ de fluctuațiile condițiilor climatice și, în special, de producerea evenimentelor meteorologice extreme: secetă, grindină, ploi excesive ș.a. Pierderile agricole afectează securitatea alimentară, ceea ce mărește riscurile de alterare a stării de sănătate a populației; determină creșterea instabilității prețurilor și riscului pentru veniturile agricultorilor. **Efectele complexe ale schimbărilor** climatice asupra agriculturii fundamentează necesitatea procesului decizional privind reducerea riscurilor în vederea menținerii standardelor adecvate ale recoltelor.
Domenii relevante	Economie, Agricultură
Nivelul de dezvoltare a indicatorului	III
Furnizori de date	Ministerul Agriculturii, Dezvoltării Regionale și Mediului, Institutele de Cercetări Științifice din subordinea Ministerului Agriculturii, Dezvoltării Regionale și Mediului
Date necesare	Suprafața totală a terenurilor cultivate; Suprafața totală a terenurilor afectate de secetă, inundații, grindină; Pierderile economice exprimate în moneda națională (Costurile totale provocate de secetă, inundații, grindină etc); PIB
Metodologii/formule de calcul	**Numărătorul** = Suprafața totală a terenurilor afectate de secetă,inundații, grindină; **Numitorul** = Suprafața totală a terenurilor cultivate; **Rezultatul** *100
Referinţe pentru metodologii	
Unitate de masură	Procente (%), Hectare (ha), Lei (LMD)
Nivelul spaţial	Naţional, Sub-naţional
Perioada de referinţă	se va completa
Frecvenţa colectării datelor	Anuală
Tendinţa aşteptată privind adaptarea	Descreştere
Sub-indicatori	Pot fi calculați mai mulți sub-indicatori în funcție de tipul de cultură și de hazard
Comentarii adiţionale	

Datele indicatorului

Sectorul	Sursa	Raionul/Municipiul	Anul de raportare	Data de începere a PNA/PSA	Data de încheiere a PNA/PSA	Surse de verificare a datelor
Agricultură	Ministerul Economiei şi Infrastructurii	MUN. CHISINAU	2016	01.01.2016	31.12.2016	
Agricultură	Ministerul Economiei şi Infrastructurii		2011	02.09.2017	02.09.2017	

Figure 6-35: Example of an Indicator Fiche of the Information System.

The *reporting template* is specific to each indicator, including the data on entities responsible for reporting, mean of data verification, type of indicator, measurement units of presented data, types of adaptation measures that have been implemented in order to decrease the vulnerability and progress in adaptation, type of clime risk the indicator refers to, time of reporting period, geographical area covered by indicator, other specific information depending on particular climate risks and hazard sector has to cope with now and in the future.

Cross-sectoral reporting is based on scorecard as a format for sectoral reporting to measure adaptation institutional progress, consisting of questions referring to sectoral enabling environment, institutional capacities, knowledge, finance and human resources, the factors identified to drive changes in Moldova's adaptation. The scorecard incorporates also gender dimension and gender concerns with regard to climate change.

The data collected based on the scorecard allow comparable measurement at sectoral level through the assessment of institutional performances and identify gaps with regard to climate adaptation. It is also a participatory process, allowing stakeholder to self-evaluate themselves with regard to climate adaptation planning and implementation, which qualify the exercise not only as an accountability procedure, but a learning tool as well.

The repository of indicators and indicators fiches, along with reporting templates of each indicator will be accessible to all participating administrations, in order to facilitate the flow of information.

The reporting process will be coordinated by the NCCC, through its Secretariat. Each sector will provide data and information according to agreed indicators and templates, for compilation and synthesis by the CCCM. The Secretariat of the CM will then produce periodical information notes to be communicated to public and reports to be submitted to the government for tracking adaptation and progress towards the overall objective of resilience. Recommendations for enhanced actions, feedback on reported information will be given to sectors.

Table 6-36: Milestones for indicator-based reporting under the NAP

Indicators	Timelines	Responsibility
Driver indicators	Annually or as needed.	Sectors
Output indicators	Annually or as needed.	Sectors
Outcome indicators	Every 4 years	Sectors
Objective indicators	Every 4 years	NCCC

The first phase of reporting that currently in under implementation, entails a baseline assessment of key indicators at all three level, including sector-specific and cross-cutting indicators.

6.4.2.4. Climate budget tagging procedure

For the Government of Moldova it is a challenge to integrate its climate related policy into core national scale frameworks, and through it, into short- to medium-term national development planning. Given its crosscutting nature, the adaptation action requires mobilization of internal and external financial resources, as well as scaling up national investments in climate finance, from both public and private sources. Therefore, as part of the M&E system, in Moldova is under the implementation the *Climate Budget Tagging* (CBT) process that aims at improving the understanding of how and how much is being spent on national climate change responses, through which programs funds are being spent, and which programs include climate change objectives (or co-benefits). This process supports the ability of the Ministry of Finance and the Ministry of Agriculture, Regional Development and Environment (MARDE) to track climate expenditures and improves their ability to ensure progress on climate change vis-à-vis Moldova's national development goals and international commitments. This process also supports the development of the financial records required to help build a climate-financing framework. The purpose of identifying (tagging) climate related expenditures is also to provide a systemic and replicable process that identifies and prioritizes climate related programs, activities and projects (PAPs) in budget proposals and budget allocations.

In conjunction with other climate change mainstreaming initiatives, CBT enables improved integration of climate change into national and sub-national planning. In this context, the need to generate robust data and the evidence upon which policy recommendations and future spending decisions are based is critical, helping policy makers understand the resource levels required, as well as the gaps, to finance the (national) response to climate change, monitor and track climate finance flows, reallocate, as necessary, the scarce resources to achieve climate-compatible national development, and increase transparency over resource allocation and management.

The CBT system ensures that the Government of Moldova can systematically identify and prioritize climate related programs, activities and projects in its sectoral and national budget proposals. The Ministry of Environment (currently merged with Ministry of Agriculture, Regional Development and Environment) and the Ministry of Finance with support from adaptation experts have developed a *Methodological Guide on Climate Tagging of the National Public Budget* [234] for the identification of climate related expenditures for technical planners use.

In the implementation of CBT system the responsibilities have been shared among Government institutions.

The Ministry of Finances has the responsibilities to:

- include the tagging of climate change expenditures, as well as changes and developments in related policies in the annual circular on developing proposals and draft budgets to the central and local public authorities (per Article 50 on Circular on preparation of annual budgets (Law on public finances and budgetary-fiscal No. 181).
- Incorporate climate change budget indicators (CCBIs) in MoF performance based budget system.
- Provide the MARDE and the NCCC with the relevant sectoral budget submissions required to assess and monitor progress on implementing climate change activities.

The MARDE, National Climate Change Commission and the Climate Change Office have to:

- provide sectoral ministries, agencies and institutions with information and support related to the tagging of climate change expenditures,
- assess and ensure the quality of the climate tagging against the guidelines and the completed Quality Assurance and Review (QAR) Forms,
- review and approve requests for new climate budget indicators (CCBIs) and, when necessary, streamline the related categorized activity tables,
- monitor developments in climate change related expenditures in coordination with the other oversight agencies and stakeholders and ensure progress in the achieving national development goals,
- in partnership with MoF, provide continuous capacity building programs to institutionalize and sustain climate change related budget indicators in the budget planning processes

Line ministries share the following responsibilities in tracking climate change expenditures:

- ensure that climate change is integrated into the annual sectoral budget proposal;
- ensure the integration of climate change PAPs in the sectoral budget proposals during the technical budget hearings;
- identify and tag climate change expenditures in the annual sectoral budget;
- as part of the annual submission of sectoral budget proposals, submit to the MoF and the National Climate Change Commission (NCCC) the list of PAPs tagged as climate change expenditures;
- if there are PAPs that do not currently qualify under the guidelines, request that the Climate Change Office (CCO) and the NCCC support for the creation of new activities or climate change budget indicators.

Under the CBT tracking system, it is proposed that the monitoring of work plans is based on output indicators at the activity level and outcome indicators at the programme level. The Climate Change Office, in coordination with the Ministry of Finance (MoF), will analyse of the report to assess the progress of implementation of the NAF and identify problems that need to be followed up.

The CBT system in Moldova has been developed to support both adaptation and mitigation components.

Four Climate Change Budget Indicators (CCBIs)/climate markers have been established for both adaptation and mitigation components (Fig.6-36).

The classification of a programme, action, project (PAP) into an adaptation or mitigation related CCBI depends on the type of activity it addresses and the key function of that activity in response to climate change:

- *policy development and governance***.** Represents measures that build resilience through comprehensive national policy frameworks, the legal framework to implement climate change policy (all elements of climate change/ green growth policies), governance into activity and delivery, as well as integration, diversification and strengthening of climate change investment effectiveness;
- *research and development.* Represents measures that build resilience by developing science & technology as a foundation for formulating policies, as well as assessing impacts and identifying measures on climate change adaptation and mitigation**;**
- *knowledge sharing and capacity building***.** Represents measures that build resilience by improving awareness of climate change and developing community capacity to respond to climate change**;**
- *climate response and service delivery***.** Represents measures that build resilience to current and future climate risks by supporting the development of a resilient society, ensuring the development of a low-carbon production economy and ensuring the sustainability of natural resources**.**

[234] Yovel, Ephrat (2016), Methodological Guide on climate tagging of the national public budget 52 p. ADA/ UNDP Project Supporting Moldova's National Climate Change Adaptation Planning Process.

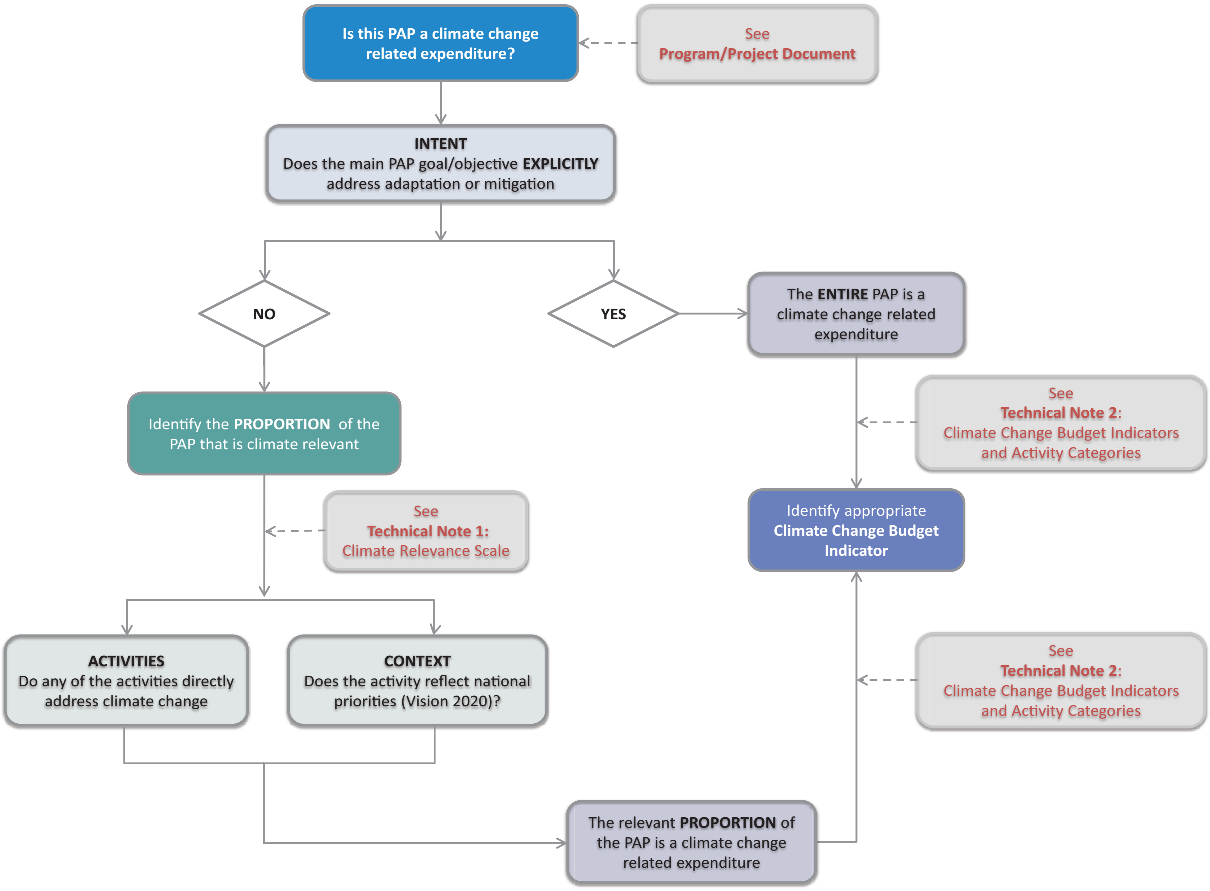


Figure 6-36: Steps to Identifying Climate Change Related Expenditures in Programs, Activities and Projects (PAPs).

Quality assurance and review (QAR) procedure accompanies climate change expenditure tagging in the performance based budget system. Ensuring the quality of the climate change expenditure data is a key part of the budget review process. Maintaining a documentary basis for climate related tagging decisions increases the transparency and credibility of the reporting on climate change expenditures by the Government. The purpose of the quality assurance and review process is to clarify the objectives and coverage of the tagged PAPs, identify adaptation and/or mitigation interdependencies and ensure progress on national climate change related targets. The MoF and NCCC are the responsible institutions to ensure the quality of the collected data and to strengthen the mainstreaming of this data into budget planning, prioritization, monitoring and reporting processes. As part of this system, a QAR working group, under the auspices of the NCCC, will examine the sectoral tagging decisions and assess the evidence base that supports the tagging decision.

CBT system is operationalized through the Government Decision on Coordination Mechanism of the Climate Change Activities.

6.4.2.5. Monitoring and evaluation procedure

Operationalization of M&E system during the implementation of the NAP1 will set a historical baseline/ benchmark for comprehensive adaptation measurement in a long-term context within multi-stakeholder participative exercise. The M&E framework is intended to expand over time and apply across to all economy sectors and across all levels of governance. Measuring and evaluation of intermediate outputs and outcomes (based on annual and biannual reporting indicators) will help to track changes at sector level in a shorter timeframe, and insure incremental improvements in adaptation and resilience efforts. The produced reports at sector and national levels based on monitoring results will be used in further planning of successive SAPs and NAPs and reported to the Government of Moldova.

The data submitted to the National Commission on Climate Change through the Information System (IS) will be stocked in the CCA IS database. The Secretariat of the NCCC will synthesize information to develop reports according to the agreed reporting framework. The reports will generalize information based on all categories of indicators, but also including expert judgement based vulnerability assessments, gap analysis, thematic feasibility reports, and other types of assessments. Up to now expert knowledge is used in vulnerability and impact assessments at sector level and is an important source of information with regard to current stage of sectoral vulnerabilities with regard to climate variability and change and their consideration in sectoral planning to augment and interpret the trends identified by indicators.

At the end of a planning cycle, the data would be aggregated into an overall "NAP impact assessment", which would synthesize all results achieved during the period and make recommendations for the next period. Concentrated effort to gather and evaluate evidences and interpret them, learn at higher level of aggregation and produce recommendations adaptation to be integrated into social, economic and environmental development is to be put at the end of each NAP cycle. The report encompassing adaptation recommendations and Lessons Learnt will play an essential role in further sustainable development and will be submitted to the Government of Moldova, through the NCCC.

The global synthesis will be produced every 4 years, or at the end of each NAP period. At a later stage will be decided if a third party like research organization, team of individual consultants or NGOs will assess the progress of implementing the NAP or setting other objective of the assessment.

At the end of each evaluation the lessons learnt will be produced and communicated to target audience along with general public.

6.5. Taking action

6.5.1. Implementation of priority adaptation actions of agriculture sector

During the last Technology Needs Assessment of the Republic of Moldova with regard to Climate Change Adaptation (2012), three top technologies have been prioritized for further implementation based on Technology Action Plan in agriculture sector: *(i) Conservation system of soil tillage without herbicides for winter wheat; (ii) Applying 50 t/ha of manure with bedding to agricultural soils once per five years; (iii) Vetch field as green fertilizer into 5-year crop rotation)*. These technologies have been incorporated in the conservation *agriculture* extensively implemented in Moldova during the period 2013-2017, aiming at continued vitality of Moldova's agricultural economy, while enhancing environmental benefits and building climate resilience. It seeks to promote the profitability of agricultural producers throughout the country while restoring or enhancing natural resources, with the special focus on soil conservation.

Conservation agriculture technologies were prioritized for the development of Technology Action Plan of in Mitigation component of TNA as well, as from all tilled soils of Moldova, around 2.55 million tons of CO_2 pollute air annually. In order to overcome soil degradation and reduce GHG emissions, a number of soils conservation technologies and practices are applied, in particular, No-till and Mini-till technologies. Therefore, implementing the aforementioned technologies a synergic effect of mitigation and adaptation efforts is achieved.

Conservation agriculture as a combined adaptation and mitigation climate measure is complex and requires an efficient enabling environment ensuring wide application of technologies and practices for both big and small-scale production. Within the *National Strategy of Agriculture and Rural development for 2014-2020,* the Ministry of Agriculture and Food Industry of Moldova sets strategic view of converting existing agricultural practices of Moldova into environmentally friendly and climate resilient agriculture, with a focus on sustainable management of natural resources. The Strategy is complemented by the Program *for Conservation Agriculture, the National Plan for Implementation of the Program for Increase of Soil Fertility, National Monitoring Program of Pesticide Residues* and *Nitrate Content in Food of Plant Origin for 2015-2020. The course of action no. 1. Risk reduction and climate change adaptation in the Agriculture Sector* of *Climate Change Adaptation Strategy of the Republic of Moldova for 2014-2020* sets specific activities to reduce the vulnerability of this sector, including those oriented toward reducing soil degradation through the promotion of environmentally friendly technologies. The *Environmental Strategy for 2014-2023 (objectives 6.3, 6.4)* also is supportive of actions aiming at improving soil quality and ecological reconstruction of degraded lands affected by landslides and of farmland protection strips at 100% applying sustainable management.

The *Program for Soil Fertility Conservation up to 2020* oriented toward improving soil fertility establishes the following overall objectives: by the end of 2020 to stop the active degradation of 887,000 ha of arable land; by 2020 to implement measures for soil conservation and fertility improvement on an area of 1.7 mil ha. To reach these ambitious targets a number of other supporting actions are to be in place, among which land consolidation is one of the most important as emphasized in the Government *Decision no.135 of 24/02/2014*. Support is granted to agricultural producers to partially offset the costs related to the notary of contracts of alienation of agricultural land (sale and purchase, exchange, donation), state tax authentication corresponding contracts and contract registration data to territorial cadastral including cadastral works if land consolidation is to form a single property. At the moment 48% of land shares are consolidated. According to the Institute of Land Management, during 2015year land consolidation projects with a total value of 648.4 million MDL, consolidating 4,560 land shares and allowing the application of restoration, application of efficient technologies have been implemented. *Article 2.4 of GD no. 352 of 10.06.2015* stimulates investments for equipment procurement for No-Till Mini-Till, up to 400,000 MDL per beneficiary, while Article 1.7 facilitates the access of farmers to capital markets, including farmers lending by commercial banks and non-bank financial institutions.

The increase in the areas with applied conservation agriculture was possible due to subsidies received for agricultural machinery purchasing allocated by the Government of Moldova along with those of IFAD project. Government support to farmers is critical during severe droughts which affect Moldova's agriculture every 2 years and cover the entire territory of the country. The damage of 2007 drought that affected agriculture can be estimated from 600 mil. USD to 1 billion USD. The negative effect of the droughts of 2012, 2015 has been recorded during the whole vegetation period.

Through the Fund for subsidizing agricultural producers, Government annually allocates financial resources to motivate the investments in the consolidation of agricultural lands and for the acquisition of No-Till and Mini-Till equipment. The subsidy system for applying conservation technologies is provided by the *Agency for Payments and Intervention for Agriculture (AIPA)*, which offers financial support for applied agriculture measures following EU rules. Currently, AIPA serves as implementing agency of several international funding organisations, including the World Bank, providing support for agriculture and rural development activities.

Promoting tolerant seed varieties with increased resistance to drought is a measure that complements conservation agriculture. During 2013-2016 years, in the Catalogue of Plant Varieties, there were registered 600 varieties of plants, of which

237 of field crops that proved higher resistance to drought conditions. Through the FAO support, the State Commission for variety testing benefited from advanced laboratory equipment to identify the best seeds in the process of varieties testing, which helped the identification and approval of early varieties resistant to adverse climatic conditions.

Application of conservation technologies requires a good knowledge of soil integrated management, therefore, efforts have been oriented toward leveraging the level of farmers' knowledge and skills with regard to conservation agriculture practices. Dedicated workshops, trainings, demo plots have been set in order to show the advantages and overcome barriers in the implementation of new conservation technologies complemented by precise agriculture techniques.

In December 2014, the Government has approved the Information system concept "*Moldova Registry of soils*" oriented toward setting regulatory standards of collected data which determine the state of the soil; database creation and clues about the main parameters of soil, amount and its credit worthiness, deliver services to consumers.

Field experiments carried out by the researchers of the national research institutions during 2013-2015 years have confirmed that the recovery of arable layer with low humus and resistance to compaction is critical for Moldova's agriculture and a complex set of soil management practices that minimize the disruption of the soil's structure, composition, and natural biodiversity are to be widely applied, in particular, No-till or Mini-till technologies, with minimum soil disturbance.

Extensive scientific and public discussions started in 2013 for approving 2014-2020 conservation agriculture programme along with "*Conservation Agriculture Regional System*" aimed to promote the implementation of conservation agriculture principles in versions tailored to soil conditions and requirements of main crops of Moldova to ensure competitive production at low-cost and with high returns, while improving the characteristics of soils and functions of agro-ecosystems, wide reproduction of pedogenesis process and solving environment issues.

The international support received by Moldova for promoting conservation agriculture technologies was a significant one, including *Special Accession Programme for Agriculture and Rural Development* (*SAPARD*), WB project *Competitive agriculture in Moldova / MAC-P-2015 - support to farmers to implement environmentally friendly practices for sustainable land management and conservative agriculture, Inclusive Rural Economic & Climate Resilience Programme - climate change resilience and inclusive development value chain* - IFAD VI, etc.

Despite reached progress, a number of serious gaps persist, in particular related to methodological aspects of applied conservation agriculture technologies and practices, which are crucial in succeeding with this type of agriculture. A number of site-level interventions (ADA/UNDP Project) were implemented to demonstrate how the strengthening of the resilience to climate pressures can be concretely carried out on a pilot project basis. Six vulnerable districts from three regions of the Republic of Moldova (North, Centre and South) were targeted for implementation of climate change adaptations. Developed *Guidance for implementing climate change adaptation options as a Small Grant Scheme* was specific about the principles for selecting the target districts for implementation of adaptation interventions, the approach for the prioritization of sectors at the local level, and the general approach for financing CCA interventions was outlined. *The Grant Scheme* was implemented in the most vulnerable districts of the country based on the *Existence Vulnerability Index (EVI),* elaborated in the Third National Communication of Moldova to UNFCCC (2014). A menu of adaptation options was developed, aimed to guide the applicants of the Small Grant Scheme. The beneficiaries of grants have been working to improve agricultural conservation practices, while helping to restore soil fertility. By promoting new agricultural technologies, like automated GPS navigation to increase the efficiency of pesticide and mineral fertilizer application, or by using improved soil conservation methods and precision machinery, the overall objective is to develop climate-resilience for farmers. At the same time, these methods minimise potential problems, including soil erosion, degradation of soil, and excessive energy consumption. The beneficiaries are promoting a wide variety of cropping practices as part of a systems approach to sustaining and improving natural resources. In addition to the conservation benefits, such systems add to the overall sustainability and energy efficiency of the entire farming operation, saving fuel and labour.

The Agriculture Component of WB DRRM Project had the objective to enhance the competitiveness of the country's agro-food sector by supporting the modernization of the food safety management system, facilitating market access for farmers, and mainstreaming agro-environmental sustainable land management practices. Compensatory grants provided to farmers in the aftermath of losses suffered as a result of the severe 2012 drought, helped avoid de-capitalization and allowed farmers to cultivate wheat and corn in 2013-2014. As a result, the country's exports of live animals, animal by-products (meat, milk, eggs), grains and cereals have not decreased, but, in fact, have increased in 2013-2014. Enhancing food safety management component of the Project is supporting activities aimed at improving human, institutional and technical capacity of the country's food safety management system, as well as ensuring regulatory harmonization with European Union requirements on food safety. Another component is supporting activities aimed at improving marketability and market integration of the RM's high value, horticultural products, where the country has proven comparative advantages in the production of fruits and vegetables. Other project components are focused on enhancing land productivity through sustainable land management is supporting activities aimed at mainstreaming sustainable land management practices and technologies, and rehabilitation of anti-erosion shelterbelts; and on supporting costs associated with project implementation and coordination across various government agencies.

Inclusive Rural Economic and Climate Resilience Programme (IRECR) is a substantial contribution to overall country's resilience having the goal to enable the poor rural people to raise their incomes and strengthen their resilience. Project's component *"Climate resilience through conservation agriculture"* aims to address the adaptation priorities identified by the Moldovan government in the agriculture sector by focusing on demonstrating the adaptation potential, supporting knowledge generation and inclusive farmers investments around conservation agriculture systems and techniques. This is expected to lead to a more resilient agricultural production that will simultaneously provide higher and more stable income to especially poorer segments of the rural population. Project contributed towards increasing rural economic growth through infrastructure development using a twofold approach: 1) to strengthen the rural sector's resilience against the increased frequency and depth of climatic and economic shocks; 2) on this platform, rural producers are able to increase production, shorten transportation time from farm to market, lower transaction costs, diversify production and engage in higher value chains that demands predictability of delivery. This in turn will increase economic growth, income and employment. Inclusive Rural Finance and Capacity Development component objective is to enhance access to financial services for the target groups, which include enhancing the capacity of the rural micro finance sector to serve rural young entrepreneurs.

6.5.2. Implementation of priority adaptation actions of health and water sectors

The two top rated measures during Technology Needs Assessment of the Health Sector of Moldova, the *Provisional posts of medical emergency care and prompt rehabilitation during critical periods of heat waves* and *Supply rural population with drinking water of guaranteed quality. Buildings of local water supply systems* have received significant Government support in their implementation.

The enabling environment of these adaptation measures is provided through the *Climate Change Adaptation Strategy of Republic of Moldova and its AP for 2014-2020 and the National Public Health Strategy* approved by the Government of Moldova in December 2013.

Health system of the Republic of Moldova has quickly moved toward developing sector specific enabling environment for implementing adaptation measures. The developed *Climate Change Adaptation Strategy and its implementation Action Plan for 2016-2023 of Health Sector* are undergoing the final stage of government approval. The policy document aims at reducing the vulnerability and risks to health by implementing sector-specific adaptation measures to climate change.

In the past several 5-6 years there is an increased trend in high-temperature heat waves in Moldova, typically associated with medium to severe drought throughout the country. Climate change increased the frequency and severity of heat waves, offering no relief and posing a particular threat to children, elderly, other vulnerable groups of persons in the cities, in particular in Chisinau, the capital of Moldova. In 2016 the SHS has issued several times yellow code warning of hot weather during July and August months and are expected for September month too.

Heat waves also place an increased pressure on the Government, who is summoning operative meetings with representative of the authorities in charge of interventions in emergency situations. During 2016 on the hot weather period, 17 rehabilitation points had been opened in Moldova, which work daily starting from 11:00- till 18:00, and provide assistance to people hit by high temperatures. Over 45,000 persons have received medical care there so far.

Provisional posts of medical emergency care and prompt rehabilitation during critical periods of heat waves measure adaptation measure prioritized in TNA TAP of Moldova currently is implemented by the Civil Protection and Emergency Situations Department of the MIA as one of the basic and regular measures during the heat waves in Chisinau and other cities of Moldova. Rehabilitation tents, equipped with health care equipment, cool water supply and health services provided by the on-duty nurse or volunteer health care staff are functioning daily during heat wave days from 11.00 until 18.00**.** The measure often is supported by health NGOs.

Opening of provisional posts of medical emergency care is complemented by other heat-related health measures during heat waves:

- SHS becoming a member of EUMetNet (Meteaoalram platform) improved its heat-health warning systems, based on monitoring of weather systems to predict extreme heat and warnings of upcoming periods of hot weather;
- mass-media announcements, promotion of air-conditioned environments in the buildings, direct communication with vulnerable populations including home visits,
- developed guiding materials distributed to health care units;
- implementation of the State Program of forest regeneration and afforestation for 2003-2020, extending the forest area by 15,800 ha.
- in squares, parks, house land, schools, kindergartens, and other institutions along the streets of towns and villages were planted 108,700 trees and bushes of different species. In Chisinau municipality 15,200 trees and bushes of different species have been planted in 2015. Territorial subdivisions of the Ministry of Transport and Road Infrastructure have planted 8.4 thousand trees and shrubs in the protection forest strips along the auto routes.

Access to safe drinking water and proper sanitation facilities adaptation measure received continuous support, strengthening national capacities for the implementation of the approved national water and health targets as part of the *UNECE/WHO-Europe Protocol on Water and Health*. Analysis of the current state of implementation of 2010 targets on water and health will feed into an upcoming new Action Plan on Environment and Health, while established in 2013 year. Clearing House Mechanism facilitates the exchange of information in the respective area. The Ministry of Environment is the responsible organization involved in the National Policy Dialogue (NPD) on Integrated Water Resources Management (IWRM), which provides a platform for implementing policies focused on achieving safe drinking water supply and adequate sanitation, prevention, surveillance and decrease of water borne disease through harmonization of water legislation of Moldova with EU directives. The MoU between MoEn and UN Economic Commission for Europe on the NPD for IWRM was signed in 2015.

The convergence of health and water legislation is of particular importance for the country, therefore the joint collaboration between health and environment sectors was seen also in the development of national policies related to climate change adaptation. Policy-regulatory support to implement this adaptation measure is provided by the Ministry of Environment that followed the alignment of national legislation with the EU environmental acquis in the approval of the *Strategy of water supply and sanitation Moldova for 2014-2028*.

During 2013-2016 continuous efforts have been made to improve water supply in rural communities of Moldova, through reconstruction and development of water supply systems and sanitation in a number of projects supported by external investments and by the National Ecological Fund of Moldova (Ministry of Environment) connecting 400,300 inhabitants to quality water pipes, in parallel new 160 km of sewerage pipes constructed. These actions resulted into an increased percentage of population access to quality drinking water sources, being 60.99% in 2015 year, and the share of the population with access to sanitation being 57.54% (2015). These efforts contribute to reaching specific objectives *of Environmental Strategy for 2014-2023: by the year 2023, ensuring access of about 80% of the population to systems and services to secure water supply and 65% to sewerage systems and services*, along with other specific *objective to ensure rational use, protection and conservation of natural resources (water, soil, subsoil, flora and fauna)*. In 2015-2016 special attention received small drinking water systems, as 600 water supply systems out of 824 (74%) qualify as small drinking water systems. The National Centre for Public Health has developed *Sanitary Regulations for small systems for drinking water supply and drinking water on surveillance* that will be approved through GD of Republic of Moldova in 2016.

The *National Program on implementing national targets under the Water Protocol on Water and Health in the Republic of Moldova,* including the Action Plan and financial mobilization started its active implementation in 2016 year ensures the continuity and sustainability of the prioritized adaptation measure under TNA TAP for health sector with specific targets to be reached by 2020.

WHO further contributed to increased resilience of the health sector by providing support to strengthen the country's competencies on the International Health Regulations (IHR). Capacities of health workers in managerial positions concentrating on the hospital sector were improved. Intensive work has been undertaken in recent years to adjust the public health system to meet the contemporary population health challenges faced in the Republic of Moldova. This includes an assessment of the essential public health functions, the development and adoption of a national public health strategy 2014–2020 and an action plan on public health. In addition, a laboratory reform was initiated to streamline services and improve the efficiency of the services infrastructure. As mentioned above, water sector adaptation action is cross-sectoral, interfering with agriculture, health forestry, and other economic sectors.

Within local level Small Grant scheme initiatives two small scale water catchments were built as a demo projects to address current and future water shortage and to develop resilience capacity of the households to climate risk factors (drought). Reservoirs use snowmelt and rainfall to bolster groundwater storage ponds, ensuring that crops can continue to be irrigated during heat waves and droughts. The reservoirs secure water resources for 5,000 residents of villages. With restored reservoirs, irrigation is available, soil erosion is reduced and crop productivity increased. This type of adaptation measures is an effective way of decreasing climate vulnerability and ensuring the food security of rural communities.

6.5.3. Up-scaling adaptation initiatives

There is a clear rationale for adaptation planning and implementation interventions in Moldova based on the existing evidence and projections of climate change impact on various sectors of the economy and on communities, therefore, in addition to implementing priority adaptation initiatives a number of strategic medium- to long-term adaptation interventions have been prepared or are under preparation. The implementation of proposed strategies and strategic concepts spans from the community to the sector levels. Under enhanced consideration were implemented pilot projects ideas and technological ideas suitable for specific sectors that have the potential for scaling up and for understanding how the implemented distinct pilot actions which relate to the adaptation process at community/household level can be combined within comprehensive strategies. The up-scaling strategies and concepts aim at bringing transformation adaptation, in particular through dissemination of technology type adaptation measures at the site level, involving actors that can bring transformation adaptation through behaviour change. Incremental adaptation promoted through discreet actions can bring some adaptation benefits (reduce losses caused by the climate variability) to Moldova's communities, however, not enough to produce changes that will bring resilience to current and future climate.

Based on the experience gained during the implementation of pilot projects during 2014-2016 yeas, the national experts have produced and discussed with beneficiaries and implementers the learned lessons and discussed them during the experience sharing workshops conducted in rural communities.

The lessons learnt specify the following factors contributing to the success of implemented pilot projects in Moldova's communities:

- relevance of implemented technology to local priorities and needs;
- correct identification of that along with adaptation to climate promotes other benefits: community development, environment, economic, social;
- increased level of interest among local population, understanding and engagement among beneficiaries;
- relative good enabling environment for implementation of conservation agriculture;
- project implementation conditions;
- intensive awareness raising and information campaigns;
- LPAs supportive to adaptation projects;
- continuous guidance and technical advice and support to farmers;
- high level of interest, understanding and engagement among beneficiaries;
- intensive consultation process;

- experienced in the area beneficiaries;
- easy interactions and communication between pilot projects implementers, consultants, technical advisers.

Outreach materials (brochure, leaflets, video spot, success stories) capturing the experience gained in the pilot projects of energy, water and agriculture sectors have been developed and distributed to local farmers, community leaders, district level authorities, sector stakeholders, NGOs, civil society. During the dissemination workshops national experts have discussed with participants various aspects of up-scaling pilot projects potential.

Based on the knowledge and experience gained during the implementation of pilot projects, national experts on agriculture have proposed a *strategic concept for up-scaling agriculture conservation* based on no-till, mini-till, strip-till and precise agriculture techniques to be implemented in all three agricultural zones of the Republic of Moldova. The strategy is analysing the existing barriers to scaling up successful interventions, describes the marketing potential of conservation technology and proposes the up-scaling concept based on replication of already implemented pilot projects, key factors for successful replication, including the analysis of political and business enabling environment, potential target groups, analysis of investments per implementation unit, required technical capacities of hard component of technologies, accessibility to seeds, integrated pest control, required crop rotation, advocacy. Technology package includes the phased actions for implementation with characteristics of implementation zones, management and monitoring approaches.

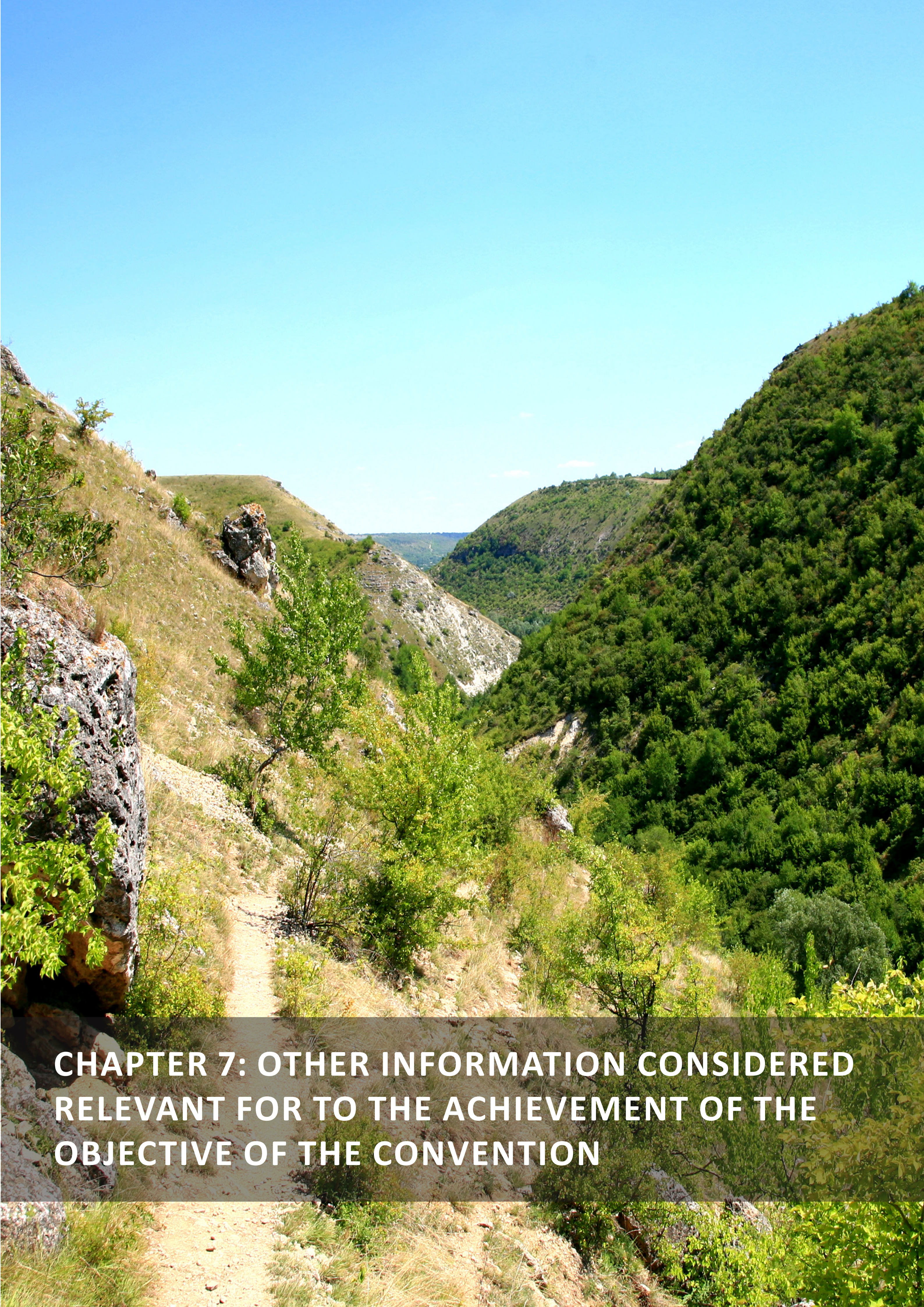
Renewable energy technologies (PV) up-scaling strategy also derives from the experience of implemented renewable energy pilot projects at the community level, along with country wide existing experience on implementing wind, solar and biofuel technologies. The document analyses the existing favourable conditions, in particular the enabling environment along with barriers for implementing renewable technologies in Moldova and proposes solutions to overcome the barriers. The up-scaling concept relies on private sector involvement and necessary Government support. A thorough analysis of sites for implementation of PV systems is given considering economic, social, and technological aspects. A number of alternative ways of implementing renewable PV technology is given considering involvement of residential, public, and entrepreneurial sectors of Moldova's in districts. A phased approach of implementation activities with all relevant details and characteristics is given along with description of actions to build capacities at district level for implementing proposed activities. A special emphasis is given to horizontal and vertical implementation of proposed activities, analysing up-scaling factors, in particular marketing conditions for renewable energy technologies.

The impact and vulnerability assessments which were carried out showed high implementation priority of *water sector adaptation measures*. The undertaken hydrological assessment showed 40% run-off of precipitation, causing significant soil erosion and floods in rural communities, without little or no contribution to farms irrigation. Implemented water management pilot projects of Grant scheme emphasised Moldova communities' development characteristics vulnerable to water scarcity and limiting their adaptive capacities. Past and on-going successful water sector adaptation efforts are to be scaled- up and enhanced through increased implementation at the local level. Currently is under the implementation of a feasibility study on adaptation intervention for the surface water small-scale infrastructure in the Republic of Moldova with the aim to enhance climate resilient development of vulnerable areas of the country and to ensure water and food security. The proposed adaptation interventions will aim at reducing water run-off and improve water availability through improved surface water management, enhance food security through livelihood diversification agriculture of fisheries, sustainable crop production, increase capacity of communities for better water operation, inform the policy makers through provision of inputs for water policy, groundwater regulation and as well as water budgeting and sharing. The implementation of intervention will help build a long-term resilience of drought-prone areas of the country considering both current and future vulnerability to climate change. It will address social inclusion by integrating vulnerable communities of Moldova, including women, in climate resilient water resources management adaptation measures at the grassroots level. Use of renewables such as solar energy and others would also be considered as an adaptation element in the water resources management and will be part of the feasibility analysis, as it will support nation-wide replication, opening of the private markets, and large-scale adoption. This adaptation intervention is supported by a Government Programme under development.

Another up-scaling strategy developed by the national experts refers to the promotion of wheat and corn climate-resistant local varieties. The strategy gives the analysis of complex climate-socio-economic vulnerably of the agriculture sector of Moldova with regard to the promotion of climate-resistant varieties, current international and national developments in the area, analysis of enabling environment, estimated costs and market potential of local varieties, analysis of barriers in promoting local varieties, strategic concept on how to promote local varieties with a phased approach, and concluding remarks on the implementation of proposed adaptation measure.

Other developed strategic concepts of technological type adaptation measures refer to the cultivation of vetch field as successive crop (intermediate) used as green manure, use of anti-hail mesh, the extension of irrigation systems as one of the main adaptation approach in combating climate drought hazard. Proposed concepts are based on the identified sectoral vulnerabilities and technological needs.

During implementation of adaptation projects, stakeholder consultations, experts meetings, public debates on the national and sub-national adaptation needs, a number of adaptation recommendations, lessons learnt from the pilot projects, experts ideas have been discussed and proposed to be developed into project fiches with further potential to be elaborated as project proposal when funding support identified. A pipeline of strategic adaptation interventions for medium- to long-term implementation of managerial and technological orientation was developed for agriculture, water, transport, and energy sectors.



CHAPTER 7: OTHER INFORMATION CONSIDERED RELEVANT FOR TO THE ACHIEVEMENT OF THE OBJECTIVE OF THE CONVENTION

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7.1. Integrating Climate Change Mitigation Issues in Social, Economic and Environmental Policies

According to the National Development Strategy "Moldova 2020"[1], *„the strategic vision of the Government in the medium and long term is the reconciliation between the need for accelerated economic development and environmental protection in line with European standards. This can be achieved by (i) accomplishing a higher rate of economic growth that allows increasing funding for environmental protection measures, and (ii) balanced regulation of the business environment, both in terms of economic and environmental impact"*. The commitment to implement the European standards in climate change mitigation has been stated in the Association Agreement between the Republic of Moldova and the European Union[2] in Chapter 17, Article 95, according to which "it is planned to develop and implement:

a) a global climate strategy and action plan to mitigate and adapt to the long-term effects of climate change;
b) a low carbon dioxide emission development strategy;
c) long-term measures for reducing GHG emissions;
d) measures aimed at preparing for selling carbon dioxide emission certificates;
e) measures aimed at promoting technology transfer based on technology needs assessment;
f) measures intended to integrate climate-related considerations into sectoral policies as well as measures on ozone layer depleting substances."

According to the same document (Annex XII), the Republic of Moldova is committed to progressively approximate its legislation to following EU legislation and climate change international tools:

1. By the year 2023 - Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for trading emission quotas for greenhouse gases in the EU community, applied to the following provisions:
   - setting up a system for the identification of the relevant facilities and for GHG identification (annexes I and II),
   - developing a monitoring, reporting, verification and implementation assurance system and public consultation procedures (articles 9, 14-17, 19 and 21).
2. By the year 2018 - Regulation (EC) no. 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated gases with greenhouse effect, applied to the following provisions:
   - the adoption of national legislation and designation of the competent authority (authorities),
   - development of reporting systems for obtaining data on emissions in relevant sectors (article 6),
   - development of implementation assurance system (article 13).

Meanwhile, in September 2015 the Republic of Moldova has submitted the Intended National Determined Contribution (INDC) document for the Paris Agreement (2015).

In view of fulfilling the commitments made under the Moldova - EU Association Agreement, as well as the INDC, the following have already been approved in early 2017:

1. The Low Emissions Development Strategy of the Republic of Moldova until 2030 and Action Plan for its implementation[3]. The strategy provides for 51 measures for reducing GHG emissions under the INDC;
2. The draft Law on Paris Agreement Ratification, adopted on 12 December 2015[4], by which the country commits to accomplish the INDC goals;
3. The Law on Renewable Energy[5]. The main objectives of the document are: achieving a higher share of energy from renewable sources of at least 17% in gross final consumption of energy in 2020, as well as at least 10% share of energy from renewable sources in the final energy consumption in transport in 2020. Accomplishing these goals will increase the energy security of the country, significantly dependent on energy imports;
4. The Moldova Sustainable Development Fund, which aims at continuation of activities to ensure the sustainability of projects funded by the Millennium Challenge Corporation and programs and projects funded by other donors[6];
5. The Energy Roadmap for 2015-2030[7]. The objective of the roadmap is to create the regulatory, institutional and organizational framework for the electricity and gas sector, as well as to ensure the security of electricity and gas supply, as a result of implementation of specific objectives set out in the Energy Strategy of the Republic of Moldova until 2030. The Roadmap identifies work packages, tasks and specific actions, distributes responsibilities among key stakeholders, considers the terms associated with proposed actions, evaluates the types of costs and quantifies indicative costs of the most important investment projects. The roadmap for electricity sector designs the assessment process, implementation progress reporting and monitoring mechanisms;

[1] Official Gazette of RM No. 245-247/791 of 30.11.2012, Parliament of the RM Law No. 166 of 11.07.2012 on approval of the National Development Strategy "Moldova 2020"
[2] Official Gazette of RM No. 185-199 of 18.07.2014, Parliament of the RM Law No. 112 of 02.07.2014 on ratification of the Association Agreement between the Republic of Moldova as one party and the European Union and the European Community of Atomic Energy and Member States , as the other party
[3] The Development Strategy of the RM until 2030 and the Action Plan for the implementation of the Government Decision of 14 December 2016. Official Gazette of RM No. 85-91 of 24.03.2017
[4] Official Gazette of RM No. 30-39 of 03.02.2017, Government Decision no. 41 of 30.01.2017 on approval of the draft Law on ratification of Paris Agreement, adopted on 12 December 2015.
[5] Official Gazette of the RM No. 69-77/117 of 25.03.2016, Parliament of the RM Law No. 10 of 26.02.2016 on Promotion of the use of energy from renewable sources.
[6] Official Gazette of the RM No. 2-12 of 15.01.2016, Government Decision No. 903 of 31.12.2015 on the public institution "Sustainable Development Fund-Moldova.
[7] Official Gazette of the RM No. 177-184 of 10.07.2015, Government Decision No. 409 of 16.06.2015 on the Roadmaps to Energy for 2015-2030.

6. The Environmental Strategy for 2014-2023 and Action Plan[8], which sets sector targets for reducing GHG emissions compared to the baseline scenario: by 25% in the energy sector; by 20% in the housing and industrial sectors; by 15% in the transport and waste sectors; by 25% of the carbon sequestration under the Land Use, Land Use Change and Forestry sector;
7. New modules in the vocational education system: Energy Plants, "Renewable energy sources" and "Heating Plants fired with solid biofuel"[9].

It should be noted that the climate change mitigation objectives of the RM shall be accomplished by implementation of economic, social and environmental priority policies approved before the Moldova EU Association Agreement was signed and the country's INDC declared. Among the most relevant policy documents are:

1. The Law on Energy Efficiency, no. 142/2010. The Law is aimed at creating preconditions for the energy efficiency improvement, including through the establishment and supporting of structures involved in the preparation and in the implementation of programmes, plans, energy services and other energy efficiency measures.
2. The National Energy Efficiency Program for 2011-2020, GD no. 833/2011.The program sets out the policies and priority actions to be implemented during the period 2011-2020, with a view to meeting such challenges as: energy price growth, dependence on imports of energy resources and on the climate change impact on the energy sector. The program will be supported by the national energy efficiency action plans, updated every three years. The goals of the programme are the same as of the Renewable Energy Law.
3. The Energy Strategy of the RM until 2030, GD no. 102/2013. The document sets concrete benchmarks for the development of the energy sector of the Republic of Moldova, including in the field of energy efficiency and development of renewable sources of energy, and its objectives are in line with the National Development Strategy "Moldova 2020".
4. The National Action Plan on use of energy from renewable sources for 2013-2020, GD no. 1073/2013. The plan defines sector objectives that would make it possible to cover 20% of the energy demand from renewable sources by 2020, and sets out the legislative, regulatory and administrative actions necessary to achieve these objectives.
5. The Law on Heat and Cogeneration Promotion, no. 92/2014. The Law regulates the principles and objectives of the State policy in the field of district heat supply systems; management of the sector by state; cogeneration, cogeneration technologies and promotion thereof; calculation and approval of regulated tariffs for heat; licensing of activities in the thermal energy sector; the rights and obligations of the thermal units, etc.
6. The Law on the Energy Performance of Buildings, no. 128/2014. The Law promotes improvement of energy performance of buildings and lays down requirements with regard to: the general framework for the buildings energy performance calculation methodology; application of minimum energy performance requirements for buildings; certification of the energy performance of buildings; regular inspection of heating and air-conditioning systems in buildings; respective monitoring systems, etc.
7. The Law on Energy Labeling, no. 44/2014. The Law establishes the regulatory framework for national measures regarding labeling and standard and additional information about products with energy-impact.
8. Establishing the Energy Efficiency Fund, GD no. 401/2012. The Decision on the Regulation on Organization and operation of the Energy Efficiency Fund. The objective of the Fund is attracting and managing financial resources in order to finance and implement energy efficiency projects and exploit renewable sources of energy in accordance with the strategies and programmes developed by the Government of the Republic of Moldova. For the period 2012-2015 circa 590 million lei, or approximately 32 million € have been set aside by the Government for the Energy Efficiency Fund.
9. The Soil Fertility Conservation and Enhancement Program for 2011-2020, HG no. 626/2011 and Action Plan for the implementation of the soil fertility conservation and enhancement program for 2014-2016, HG no. 138/2014. The Program provides for the implementation of the soil fertility conservation and enhancement measures by offsetting losses of humus in the soil with complex fertilization with organic fertilizer (manure and composts). The goal of the documents is the long-term preservation of quality and production capacity of the soil to assure the country's food security. The productivity of agricultural crops, the development of the animal husbandry sector, export of agri-food products, well-being and ecological situation in the country depends to a large extent on the quality of soils.
10. The National Strategy for Agricultural and Rural Development for 2014-2020, GD no. 409/2014. The Strategy implies the use of modern agricultural land and water management practices; afforestation of low quality or unproductive agricultural lands to increase biodiversity, reduce soil erosion and ensure conservation of water resources, etc. In the forestry sector the strategy provides for the afforestation of low quality agricultural lands to increase biodiversity and reduce soil erosion, also contributing to the conservation of water resources.
11. The National Plan for expansion of afforested areas for 2014-2018, GD no. 101/2014. The Plan provides for the expansion of forest vegetation on an area of 13.041 thousand hectares and provision of planting material required for expansion works.
12. Waste Management Strategy of the Republic of Moldova for 2013-2027, GD no. 248/2013. The Strategy provides for the development of the solid waste management integrated systems through harmonization of legislation; division of the country's territory into 8 waste management regions; increasing the amount of waste recycled and recovered by 20-30% until 2025; reducing the amount of disposed biodegradable waste; development of waste disposal regional infrastructure through construction of 7

[8] Official Gazette of the RM No. 104-109 of 06.05.2014, Government Decision No. 301 of 24.04.2014 on approval of the Environmental Strategy and Action Plan for 2014-2023.
[9] The Ministry of Education of the Republic of Moldova, Order no. 858 of 04.10.2016 on approval of curricula for secondary technical vocational education.

SWDs and 2 bio-mechanical treatment plants in Chisinau and Balti; re-cultivation of at least 50% of the number of non-compliant landfills by 2027.

Climate change mitigation issues continue to be reflected in a series of the country's policies which are currently under development or drafted for public debate. They include:

1. Government Decision approving the Regulation on the measures aimed at reducing emissions from air-conditioning systems in motor vehicles, which lay down the provisions regarding installation of air-conditioning systems intended for vehicles with a view to placing them on the market and refilling the air conditioning systems of any vehicle with fluorinated gases with greenhouse effect with a global warming potential higher than 150. This GD partly transpose the Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Directive 70/156/EEC.
2. The Methodology for calculating the ceiling prices and fixed tariffs for electricity produced from renewable energy sources, intended to establish for all producers of electricity from renewable energy sources of a single method for calculating the ceiling price which will be proposed to the Government to be used for tendering and setting fixed tariffs for electricity produced from renewable energy sources by eligible producers who own or will own power plants with a cumulative power that does not exceed the capacity limit set by the Government.
3. The draft amendments to the Law on Environmental Pollution[10], setting the payments for environment pollution from use fluorides.

7.2. Activities Related to Technology Transfer

It is generally recognized that technology transfer plays a decisive role in the attainment of the direct GHG emissions reduction objective, given that most of the technologies used are sources of emissions and substitution of obsolete technologies with more up to date imminently entail reduction of direct GHG emissions.

Among many definitions of the concept of transfer of technologies, the proposed deserve attention by the Global Environmental Fund (GEF), under which transfer of technology means:

> *"... a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders, such as governments, private sector entities, financial institutions, non-governmental organizations and research/education institutions...*
>
> *…The term "transfer" includes the diffusion of technologies and technological cooperation among countries and within them. It covers technology transfer processes between developed countries, developing countries and countries with economies in transition. This includes the process of learning to understand, use and reproduce the technology, including the ability to choose and adapt them to local conditions and to integrate them with indigenous technologies."*[11]

The IPCC identifies three major dimensions needed to ensure the effectiveness of technology transfer: capacity building, enabling business environment and technology transfer mechanisms.

7.2.1. Capacity building

Until now a series of innovation and technology transfer capacity building actions have been undertaken in the Republic of Moldova, strictly geared toward reducing GHG emissions.

So, in 2004 the Agency for Innovation and Technology Transfer (AITT) was established. The AITT is subordinated to the ASM and is a specialized organization providing technological extension and aims to coordinate, stimulate and implement mechanisms, innovation and technology transfer mechanisms. Currently, AITT uses only two instruments to support innovation: innovation and technology transfer projects, and support to scientific-technological parks and innovation incubators. 284 technology transfer projects were implemented during 2005-2015. 33 innovation and technological transfer projects intended for 2014-2015 were submitted for competitive selection, of which 19 were financed in 2014, with 8 665 700 lei from the state budget and 11 905 000 lei from private sources, of which 11 projects resulted in patents, 2 projects in patent applications submitted and 6 projects were based on know-how[12].

It should be mentioned that technology transfer projects are approved for funding by the Supreme Council for Science and Technological Development, while implementation of funding and monitoring is carried out by the AITT. Although one of the conditions for applying for such competitions is that at least 50% of the funding should come from the private sector, the applicants can only be the institutions accredited by the National Accreditation and Attestation Council. The projects promoted by AITT enjoy tax benefits. Unfortunately, data relating to the continuity of such projects, the economic benefits resulting from their implementation are not reflected in any of the activities reports of the organizations managing the appropriate budget allocations.

According to its functions and direct tasks, in conformity with the Law on Scientific-Technological Parks and Innovation Incubators, the AITT jointly with the Academy of Sciences of Moldova (ASM), have created the scientific-technological parks and innovation incubators which are the best solution for domestic firms, as they provide a range of strategic and logistic services for businesses to grow.

The current innovation infrastructure of the Republic of Moldova consists of 3 scientific-technological parks and 8 innovation incubators that have benefited from funding from public sources: "Academica", I.I. "Inovatorul", PST "Inagro", PST "Micronanoteh", I.I. "Politehnica", I.I. "Inventica-USM", I.I. "Nord", I.I. "Innocenter", I.I. "Antreprenorul Inovativ", I.I. IT4BA, I.I. "Media Garage"[13]. The investments made by the state in these entities infrastructure development totaled to 9332.5 thousand MDL.

[10] Official Gazette of RM No. 54-55 of 14.03.1998, Parliament of the RM Law No. 1540-XIII of 25.02.1998 on environmental pollution payments

[11] <http://www.ipcc.ch/ipccreports/sres/tectran/index.php?idp=517>.

[12] AITT, Managerial activity report 2014 (2011-2014). Chisinau 2015

[13] AITT, Annual Activity Reports.

Similarly to technology transfer projects, in addition to support from the state budget, these entities come with own financial contribution. Co-financing effected by the incubator's administrator.

The Organization for Small and Medium Enterprise Development is active in the Republic of Moldova (ODIMM)[14]. This is an implementation agency under the Ministry of Economy and Infrastructure of the RM. Among the functions performed by ODIMM are the development and implementation of small and medium enterprises (SME) programs and projects, provision of consulting and training services to SME managers and employees, creation and development of business incubators network, supporting of clusters and innovative networks formation. ODIMM implements the support programs approved by the Ministry of Economy and Infrastructure of the RM, but these programs are of general nature and do not specifically target innovative companies. Capacity building in SME is carried out through training projects "The national programme of economic empowerment of youth" (PNAET) and "Effective Business Management" (GEA), and 4 national projects and 34 international projects.

Creation of industrial parks, which contribute to capacity building, is in full swing. An industrial park is a limited area, where the equipment and production infrastructure is located, and where economic activities, mainly industrial production, provision of services, research and technological development are carried out, all enjoying specific incentives. An industrial park can be set up for a period of 30 years, either on public or private land, either through green investment or through public-private partnerships. The new law on industrial parks was passed in 2010. From the date of entry into force of the Law on Industrial Parks (2010) and by the end of 2015, 9 enterprises have obtained the status of industrial parks on the basis of Government Decisions: P.I. "Tracom", Chisinau; P.I. "Bionergagro", Drochia; P.I. „Cimislia", Cimislia; P.I. "Raut", Balti; P.I. "CAAN", Straseni; P.I. "Edinet", Edinet; P.I. "Triveneta Cavi Divelopment", Straseni; P.I. "Comrat", Comrat and P.I. "FAIP", Durlesti.

Investments of 262.6 million € are envisaged to create the technical and production infrastructure, which will create 9796 jobs. Since the beginning of industrial parks total investments amounting to 723.0 million lei have been already made. By the end of 2015 the industrial parks provided employment to 1859 people. According to calculations, one lei invested in industrial parks (since 2011) generate 1.9 lei as sales revenue and 0.4 lei as income in the public national budget (as fees and payments).

Since 22 September 2011, the RM has become a partner of the *Enterprise Europe Network (EEN)* by creating a consortium between the Chamber of Commerce and Industry, the Agency for Innovation and Technology Transfer and the Small and Medium Enterprise Development Organization.

These partners have proposed the establishment of a Center offering a wide range of services for the business environment intended to facilitate access to the European market and implement innovative technologies in operational activity.

[14] <http://www.odimm.md>

The main objective of the new EEN Center in the RM is to provide:

a) integrated services to support innovation and promote trade and economic relations within the business community in the country.
b) innovation and technology transfer services, including:
   - providing information relating to innovative policies, legislation and actions of innovation (including Eco-Innovation);
   - promoting international technological cooperation opportunities;
   - participation in events in the EU, such as: European days dedicated to innovation, information stands, presentations at conferences and exhibitions;
   - creating and distributing technological profiles of companies;
   - organizing study visits, seminars, workshops to promote innovation and technology transfer across SMEs [15].

Establishment in 2010 of the Energy Efficiency Agency (EEA)[16] and of the Energy Efficiency Fund (EEF) in 2012[17] had a significant impact on capacity building. The EEA's mission is to oversee the developments in energy efficiency and renewable energy sources, ensure the preparation and submission of summary programs, assess the investment projects, drafting of legislation, and creation of information database in the areas of its activity. While carrying out its mission, the EEA is responsible for ensuring and supporting the accomplishment of the National Energy Efficiency Program objectives, providing necessary assistance in developing local energy efficiency programs and plans, developing renewable energy sources, and monitoring implementation.

Pursuing implementation of the state policies in energy efficiency and renewable energy sources, the EEA has developed the technical assistance program "Strengthening the Capacity of the Ministry of Economy of the Republic of Moldova in Energy Efficiency and Renewable Energy Sources", financed by the Swedish International Development Agency (SIDA), a program aimed at strengthening the EEA's capabilities and capacity building for the General Directorate for Energy Security and Efficiency of the Ministry of Economy of the Republic of Moldova.

Also, aiming at capacities building in energy efficiency monitoring and verification, the EEA contributed to implementation of the project "GHG emission reduction through the improvement of energy efficiency in the industrial sector of the Republic of Moldova", financed and implemented by the United Nations for Industrial Development (UNIDO), where the EEA is the main beneficiary for the first component of the project.

Having already sufficient experience, the EEA is systematically involved into capacity building of individuals and entities engaged in promoting energy efficiency and RES, including at the local level.[18]

[15] <http://info€pa.md/een/>
[16] The Decision of the Government of the Republic of Moldova No. 1173of 21.12.2010 on Energy Efficiency Agency.
[17] Government Decision No. 401 of 12.06.2012. Official Gazette No. 126-129/448 of 22.06.2012.
[18] <http://www.aee.md/primele-stiri/buletin-comunicat-anun/479-consolidarea-capacit-ilor-locale-pri-vind-efectuarea-auditului-energetic>

Aiming at meeting the energy efficiency oversight and monitoring obligations, trained energy managers have already been appointed within local public authorities, in accordance with the provisions of the Law no. 142 of 02.07.2010 on Energy Efficiency and Government Decision no. 833 of 10.11.2011 on the National Energy Efficiency Programme for 2011-2020.

Capacity building activities are also carried out through universities. Thus, in 2013-2016 the Tempus project "Technology transfer network-TecTNet" was implemented, with participation of 11 partners from Moldova and the European Union (EU). The main objective of the project was to strengthen the institutional capacity of universities in the Republic of Moldova in terms of knowledge and technologies transfer, innovation and intellectual property management.

The direct beneficiaries of the project are four universities in the Republic of Moldova: Technical University of Moldova (TUM), Agrarian State University of Moldova (USUM), Moldova State University (MSU) and State University "Alecu Russo" of Balti. Transfer of good practices has been provided by the partner universities in the EU with a vast experience in the field: the University of Sannio Benevento (Italy), the Technical University "Gheorghe Asachi" of Iasi (Romania), Technical University of Košice (Slovakia) and the Higher Technical Institute in Lisbon (Portugal).

A special impact on capacity building in climate change mitigation was made by the project "Low Emission Capacity Building Program" (642 thousand USD)[19]. The project was focused on three components: national inventory system development; formulation and development of the NAMA and MRV system to support NAMA implementation and evaluation, and of the Low Emission Development Strategy. Four detailed NAMAs have been developed under the second project component, these four being chosen from 136 mitigation measures identified by the experts. Two international experts and four national consultants (responsible for overall drafting of NAMAs) and 7 national experts responsible for drawing up concrete chapters, participated in NAMAs development. A total of 10 capacity building workshops and trainings on NAMA development held, with 15-40 participants in each event.

The information program needed to create the local level database for energy managers is currently being developed with the support of the USAID-funded projects. The Energy Efficiency Guide for the public sector[20] has already been developed under the same project. Under the EUREM Program, launched in Moldova for 2011-2014, Following the signing of the Memorandum of Understanding on promotion of energy efficiency managers training, signed by the Chamber of Commerce and Industry of the RM, the Ministry of Economy of the Republic of Moldova, the German International Cooperation Agency (GIZ) and East Germany's Economic Committee, a wide group of energy managers have been trained under the EUREM Program[21], a success in terms of strengthening the country's capacity in energy efficiency. In the same context, with the support of the USAID funded SYNENERGY Program capacity building trainings were organized for energy managers. The trained managers have acquired practical skills needed for development, design, implementation and monitoring of projects designed to increase the efficiency of energy processes within a public or private facility.

Significant contribution to capacity building was also made by:

- MoSEFF and MoREEFF (residential sector) [22] credit lines launched by the EBRD in 2010 to promote energy efficiency and renewable energy projects[23]. The effectively implemented projects are widely publicized in the country and the beneficiaries, represented by businesses and residential sector initiate new energy efficiency actions;
- EU-MOLDOVA bilateral program which included a financing package of about €78.6 million for the year 2011, meant for the energy sector, mainly for the implementation of renewable energy sources and promoting energy efficiency, including implementation of the "Capacity Building of the Ministry of Economy in energy efficiency and renewable energy in Moldova" project, implemented in 2011-2015. The amount of €42.6 million was allocated for 2011-2016. The package included the costs for comprehensive strengthening of institutional capacities of the Chamber of Commerce and Industry. For the Energy and Biomass Project 2011-2017, initially €14 million were earmarked, followed by another € 9.41 million in 2015; €1.5 million were allocated for the project "Renewable Energy Use (2010-2013)"; 1.25 million € were allocated for "FEEF-MO, financing for energy efficiency"; €0.9 million were allocated for "Waste Management (2009-2013)" [24]
- Energy Package launched by the World Bank[25], etc.

Non-governmental organizations, among which the Technology Transfer Network Moldova (RTTM) had a special role in capacity building. The purpose of the RTTM is to promote innovation and technology transfer in the RM by creating and promoting an effective platform for interaction between key stakeholders and organizations involved in this process[26].

7.2.2. Enabling Business Environment

Overall, the current business environment in the Republic of Moldova, including technology transfer aimed at mitigating GHG emissions is described in the National Development Strategy "Moldova 2020", identified as a high priority of the country in the coming years. According to the strategy, the environment itself is characterized by unjustified financial costs, which essentially exceed the same in developed countries, which does not motivate fair competition targeting productivity and innovation.

In the World Bank's „Doing Business" international ranking in 2016, the RM ranks 44th out of 190 countries, along with Croatia (43) and Cyprus (45), Romania ranking 36[27].

In the global competitiveness ranking 2016-2017, the RM ranked 100 out of 138 countries[28], being over ranked by most countries in the region and CIS countries. According to the same report, entrepreneurs have highlighted the following

[19] <http://amp.gov.md/contentrepository/downloadFile.do?uuid=d67dcbfe-3161-48dc-963b-3fb64f7c6190>
[20] <http://www.comunicate.md/index.php?task=articles&action=view&article_id=7054>.
[21] <http://dezvoltarea.chamber.md/ro/proiecte/39-programul-€pean-energy-manager-%E2%80%93-eurem>
[22] <http://moreeff.info/statistica-moreeff/>.
[23] <http://www.moseff.org/>.
[24] <http://infoeuropa.md/asistenta-ue-pentru-moldova/>.
[25] <http://www.mepiu.md/>.
[26] <http://www.rttm.md/>.
[27] <http://www.doingbusiness.org/~/media/WBG/DoingBusiness/Documents/Annual-Reports/English/DB16-Full-Report.pdf>
[28] <http://www3.weforum.org/docs/GCR2016-2017/05FullReport/TheGlobalCompetitivenessReport2016-2017_FINAL.pdf>

factors as main issues in business, in order of priority: (i) political instability; (ii) limited access to funding; (iii) corruption; (iv) public administration inefficiency; and (v) instability of the Government.

In terms of improving the business environment of the Republic of Moldova and attracting investors, the World Bank's study "Cost of Doing Business"[29], conducted in 2016, shows that businessmen do not feel a change in the situation. Only 13% of the companies' managers in Moldova could find that business environment really improved in 2016, 60% did not find any change, while 27% believed that business environment worsened.

Another international benchmark is the Economic Freedom Index, developed by the *„The Heritage Foundation"*[30]. This indicator assesses the degree of State intervention in economic activity on the basis of 10 sub-indicators: freedom of business, freedom of trade, fiscal freedom, monetary freedom, State's expenditures, freedom of investment, financial freedom, property rights, freedom from corruption and labor freedom. The RM only ranks 87 at this indicator, from 186 countries.

The problems of business environment are present at all stages of the business life cycle: from the launching, in the process of business development and liquidation. The administrative system of the State in terms of granting permits and effecting inspections is far from perfect.

Removing regulatory constraints and unjustified costs would create preconditions for a more dynamic and sustainable growth, encouraging domestic and foreign investments.

The Moldova 2020 Strategy and the "Small and Medium Enterprises Development Strategy for 2012-2020" aim to remove currently existing barriers, so that the risks and costs associated with each stage of the business life cycle, including technology transfer, become lower than in other countries in the region by 2020.

The results of these Strategies implementation can be found in the EU Report on the Implementation of the Association Agreement during 2014 and beginning of 2017[31]. According to the latter, the business was still plagued by corruption and widespread inconsistency, during this period, thus negatively affecting the investment climate. Consolidation of economic interests in the hands of a limited number of people continues. This creates an interference risk for public policies. Access to finance, particularly for SMEs remains difficult. In order to improve conditions for businesses, economic Council's by the Prime Minister, revived during the period under review and which brings together institutions of the State, the business community and civil society organizations, has adopted a series of measures to promote effective business activity. Aiming at medium and long-term development of SMEs an enabling legal framework has been created, including the following approved legislation:

- Small and Medium-sized Enterprise Development Strategy for 2012-2020[32] (2012) and the corresponding Action Plan for 2015-2017;
- The Strategy for the Reform of the Regulatory Framework for the Entrepreneurial Activity for 2013-2020 (2013) and the Action Plan for its Implementation in 2016-2017[33];
- The Law on Small and Medium-sized Enterprises (2016)[34];
- The Law on Support to Small and Medium-sized Enterprises (updated in 2016)[35];
- The Law on Peasant Farms (updated in 2016)[36];
- The Law on Business Investments (updated in 2016)[37];
- Law on Entrepreneurship and Enterprises (updated in 2016)[38].

The success of industrial and entrepreneurial policy of the RM largely depends on the extent to which the country is able to assimilate modern technologies and products and diversify production and exports. The Republic of Moldova needs to make further efforts to consolidate the market economy structures and competition.

7.2.3. Technology Transfer Mechanisms

According to the IPCC report on "Methodology and Technology Aspects in Technology Transfer"[39], technology transfer mechanisms include:

- The National System of Innovation,
- Official Development Assistance,
- Global Environment Fund,
- The Multilateral Development Banks,
- The Kyoto Protocol Mechanisms.

7.2.3.1. The National System of Innovation

R&D and innovation systems in the Republic of Moldova have different levels of development, defined by the historical context: the R&D system has a rich history behind it and is quite mature, while the innovation system is still at early development level[40].

The research system in the country is a centralized one, the decision-making power and the tools for managing the research being concentrated at the Academy of Sciences of Moldova, according to the Code of Science and Innovation of the Republic of Moldova[41], a document regulating the legal relations related to development and promotion of the state policy in science and innovation, scientific research activity, innovation and technology transfer, scientific-technological information, accreditation of organizations in the field of science and innovation, certification of highly qualified scientific and scientific-teaching staff, protection of intellectual property, the legal status of entities in the field of science and innovation.

Since 2008, the funding for R&D has been shrinking steadily, from 0.63% of GDP in 2008 to 0.39% of GDP in 2015[42], with respective impact on the achievement of the ASM's goals. At the same time, the country successfully joined the EU FP7 financing

[29] <http://www.doingbusiness.org/data/exploreeconomies/moldova>
[30] <http://www.heritage.org/international-economies/report/2017-index-economic-freedom-trade-and-prosperity-risk>
[31] <http://info€pa.md/files/aa-3.pdf>
[32] <http://lex.justice.md/viewdoc.php?action=view&view=doc&id=344806&lang=1>
[33] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=350792>
[34] <http://www.mec.gov.md/sites/default/files/document/attachments/l_e_g_e_privind_intreprinderile_mici_si_mijlocii.docx>
[35] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=316995>
[36] <http://lex.justice.md/md/311579/>
[37] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=312880>
[38] <http://lex.justice.md/viewdoc.php?id=311735&lang=1>
[39] <http://www.ipcc.ch/ipccreports/sres/tectran/index.php?idp=517>.
[40] Draft National Strategy on Innovation for 2012-2020. <http://www.idsi.md/files/file/2011_10_25-Strategia%20Inovarii_RO.doc>.
[41] <http://lex.justice.md/md/286236/>
[42] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=361816>

program, and in 2014 signed the agreement on participation of the Republic of Moldova in the EU framework programme for research and innovation (2014-2020) - Orizont 2020.

Every 4 years, at the proposal of the ASM, the Parliament approves the priorities for R&D, coordinated with the ministries (Government), to guide channeling the research efforts.

The R&D system comprises a number of actors, including the ASM, which is the key actor with functions and policy and implementation units, as well as research institutions, the Agency for Innovation and Technology Transfer (AITT), the State Agency for Property Intellectual (AGEPI), 3 STP ("Academica", "INAGRO" and "Micronanotech"), 8 innovation incubators, universities and SME Development Organization (ODIMM).

The rate researchers in the Republic of Moldova is about 80 researchers to 100 000 population, 4 times lower than in the EU and Russian Federation, however, with insignificantly lower indicators than those reported by Romania and China.

In the RM 71% of the total number of research establishments are public research institutions, 18% - are part of higher education institutions, and 11% belong to the entrepreneurial / private sector. In the EU public research institutions account for 13% of the total number, universities account for 40%, entrepreneurial institutions - for 45%.

In the RM the unit costs per researcher are about €8 thousand, while the European average exceeds €150 thousand. In comparison with the Russian Federation and Romania, the Republic of Moldova allocates 3 times less financial resources per one researcher, and 80 times less compared to the USA[43].

After the adoption of the Code, the responsibility for promotion of innovation activity has been left to the ASM only, which, though has the innovation generation tools, has no direct influence on the real sector, and the funding earmarked for research was too small to allocate sufficient funds for the development of various kinds of innovations, to help businesses innovate. However, since 2005 over 4.5% of public funds allocated to research and development were earmarked for innovation activities, amounting to a level of one million euro per year. These funds were used for innovation infrastructure development, but also for funding of technology transfer projects and "start-ups". At the same time, the Technology Transfer Projects web page on the ASM's website contains no information on this subject.

In the Republic of Moldova innovation policy is centralized and focused on supporting application of internally developed innovations, rather than the needs of domestic enterprises[44]. At the same time, technology transfer and improvement of technological absorption capacity of enterprises are less taken into account by national policies. The reduced participation of the private sector in the ASM governance and innovation activity generally means that the ASM has a limited ' feedback ' from companies, in terms of efficiency and the relevance of its activities and policies. The current institutional framework seems to be geared toward basic research. Partnerships with the private sector, managed by AITT, are underdeveloped and the current innovation policy is not focused on the development of R&D in the private sector. Private companies are practically excluded from financing from the State budget for science, because only entities accredited by NCAA are eligible. Accreditation criteria are strictly academic-oriented, and are irrelevant to the interests and capabilities of the entrepreneurial sector[45].

Overall, the research and innovation in Moldova, is rather academic by nature. Open innovation models seem to be neglected. Only technological innovation seems to be taken into consideration, although other forms of innovation (organization, design, marketing, etc.) can be extremely beneficial for small companies, especially in the service sector[46].

Given the above-mentioned constraints, in early 2017 the Government proposed a concept of the national research and innovation system reform designed to streamline the research and innovation system, in particular, the process of allocation of budgetary appropriations for research and development, innovation and technology transfer, in order to increase the impact of research and innovation on the national economy. In this regard, it is proposed to de-concentrate the elaboration, implementation, monitoring and development policies impact assessment functions from one single institution, as the current situation is.

Thus, development of research policies will be vested upon the Ministry of Education, while the Ministry of Economy will be responsible for innovation and technology transfer related policies. Executive functions in terms of competitive funding, facilitating cooperation, evaluation of results, drafting policy proposals and promotion of science will be delegated to the National Agency for Research, Development and Innovation (NARDI).

At the same time, in order to ensure a relevant expertise of science and innovation development policies, an unbiased cross-sectoral approach, and monitoring the NARDI's activity, the Research, Development, Innovation and Technology Transfer Council will be established by the Prime Minister's Office. This Council will be composed of notorious personalities from various fields and will represent an advisory platform, which will draw the guidelines for research and innovation development, will provide advice and expertise.

Another novelty is the elimination of scientific accreditation requirement and introduction of minimum performance criteria for accessing funding from the budget, and removal of barriers for actors from other areas, businesses and civil society, to participate in the research and development activities. The reform of the national research and innovation system will be carried out in parallel with the ASM reform[47].

The international experience has shown that in order to reduce the barriers to technology transfer intermediate bodies are needed related to information, management, technology and financing. Technology intermediaries include governmental agencies, energy companies, services, non-governmental organizations, university liaison departments, regional technology centers, research and technology organizations, electricity utilities and trans-national networks[48]. A good part

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[43] <https://soros.md/files/publications/documents/Studiu,%20%E2%80%9EEvaluarea%20capacit%C4%83%C8%9Bilor%20de%20cercetare%20a%20institu%C8%9Biilor%20de%20%C3% AEnv C4%83%C8%9B%C4%83m%C3%A2nt%20superior%20din%20Republica%20Moldova%E2%80%9D.pdf>

[44] OECD. Competitiveness and Private Sector Development, the Republic of Moldova 2011: Fostering SME Development, Competitiveness and Private Sector Development, OECD Publishing, p. 126.

[45] http://idsi.md/files/file/publicatii/sistemul-de-cercetare-dezvoltare-din-republica-moldova-reflectat-in-rapoarte-internationale.pdf>

[46] Inco-Net EECA. S & T Policy Mix Peer Review since 1994. 26 June 2012, presentation at ASM

[0] <http://www.moldpres.md/news/2017/03/07/17001818>

[48] <http://www.ipcc.ch/ipccreports/sres/tectran/index.php?idp=517>.

of these are present in the RM and described above in section 6.1.1 on capacity building.

7.2.3.2. Official Development Assistance

The National Development Strategy „Moldova 2020" sets out the country's long-term economic development sustained by internal forces through sustainable development. Until the change of development paradigm, however, the Republic of Moldova will continue to count on the development partners' support.

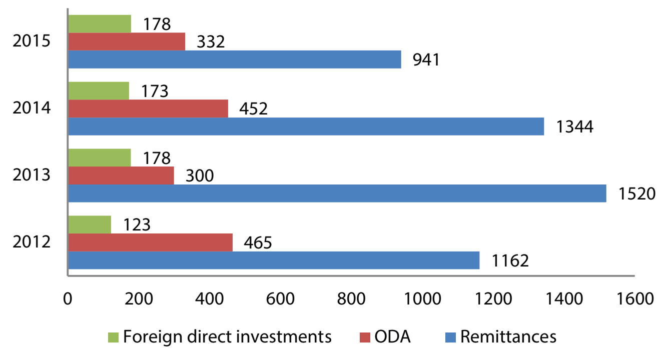
Official Development Assistance (ODA) is divided into grants and credits to developing countries, granted for macroeconomic consolidation (by the IMF), concessional loans to the Government (in particular, by IDAs), grants for direct budget support (by EU, WB, DFID), technical assistance from a number of multinational organizations and bilateral donors[49].

With the purpose to officialize the development assistance, the Republic of Moldova has acceded to the Paris Declaration (2005), the Agenda of the Accra action (2008), the Busan Commitments (2011) and Mexico Communicate (2014). Detailed information on official development assistance provided to the Republic of Moldova can be accessed on-line from the External Assistance Management Platform (AMP)[50], where one can find data about 1854 ongoing projects, and finished ones. The following are the most relevant information on this subject.

Total official development assistance commitments related to the Republic of Moldova amount to 4524.4 million euro, with 2461.55 million euro already disbursed on 16.03.2017.

The amount of disbursed external assistance, as share in GDP is maintained during the years 2012-2015 below the level of 10%, tending to decrease from 8.25% in 2012 to 5.68% in 2015. On the other hand, the share of external resources in the National Budget accounted for 21.59 % in 2012 and 15.87% in 2015. At the same time, it should be noted that budgetary and financial sustainability of the Republic of Moldova continues to depend on the amount of external assistance provided.

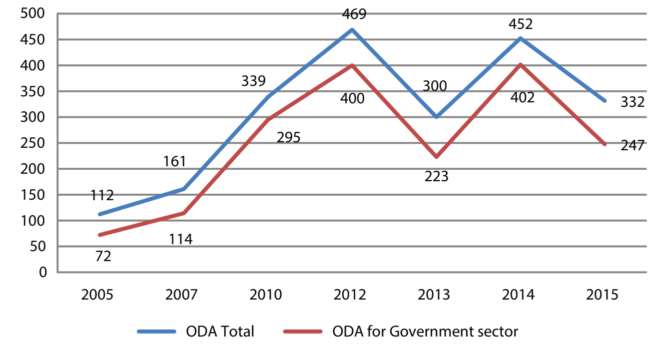
Figure 7-1 shows the comparison between the external assistance and remittances transferred from abroad to individuals through Moldovan banks, and foreign direct investments, also considered as economic growth flows.



Source: AMP.

Figure 7-1: Major financial flows for the Republic of Moldova, mil. EUR.

During 2005-2015, the amount of ODA showed an upward trend, increasing in 10 years by about 3 times, from 112 million EUR to 331.6 million EUR (Figure 7-2).

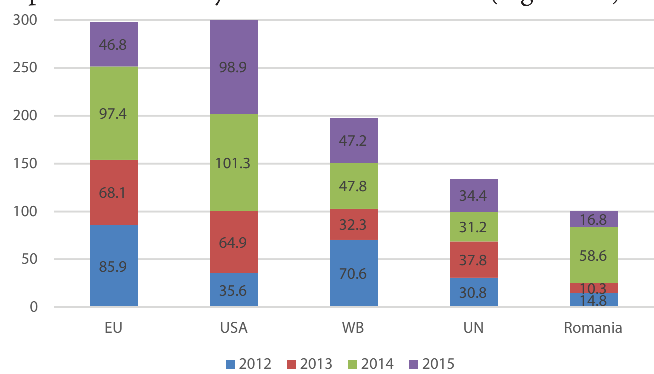


Source: AMP.

Figure 7-2: Dynamics of ODA disbursements, mil. EUR.

During the same time period the amount of funding for Governmental sector increased by 3.4 times, from 72 million euro to 247.4 million euro. At the same time, the amount of disbursements in 2015, compared with the previous year, showed a decreasing trend - the total ODA dropped by 26.7%, and for the Government sector - by 38.4%. The reduced external financing in 2015 was caused by the suspension of the budget support programs offered by the EU and the World Bank, in the context of political instability and the financial and banking crisis in the Republic of Moldova[51].

Among the development partners, with whom the Republic of Moldova collaborates to fulfill the development agenda, the EU and the United States continue to be the biggest and most important donors by the disbursed amounts (Figure 7-3).



Source: AMP.

Figure 7-3: Dynamics of ODA disbursements by development partners, mil. EUR.

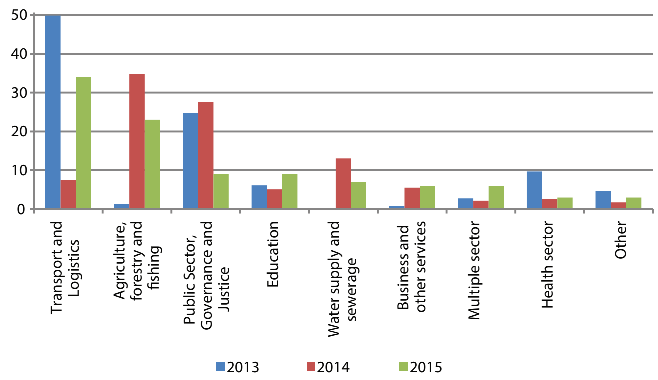
Given the specifics of the projects and their implementation, the development partners ' rankings change every year. Thus, according to the data presented by development partners for 2015, the top donors according to the amounts disbursed are: the U.S. Government, the European Union, the World Bank, United Nations Agencies (the UN), the European Investment Bank (EIB) and Romania. During 2015 over 100 new projects were initiated, of which 70 have been promoted with the EU financial support.

Regarding the ODA structure by sectors, it is shown in Figure 7-4.

[49] The analysis of the evolution of foreign assistance offered in the period 2001-2007, <http://www.e-de-mo-cracy.md/fles/prioritati-guvernare-2009.pdf>.

[50] <http://amp.gov.md/portal/>

[51] <http://amp.gov.md/portal/sites/default/files/inline/aod_2015_report_md.pdf>



Source: AMP.

Figure 7-4: ODA share by sectors, %.

As seen in Figure 6-4, most of ODA during 2013-2015 was targeted to transport and logistics, agriculture and forestry, as well as to the public sector, governance and justice.

As per the Government Decision no. 561 of 19 August 2015[52], the Government preferred technical assistance and financial assistance in the form of grants. The loans also include at least one 25% grant element. The share of grants and loans in ODA is presented in Table 7-1.

Table 7-1: Share of grants and loans in ODA

Financing	2012	2013	2014	2015
Loan	47%	44%	51%	43%
Grant	53%	56%	49%	57%

Source: AMP.

Notably, the ratio of loans/grants provided as ODA was around 50/50 over the past four years. However, it is not possible to identify for sure the funding intended exclusively for GHG emissions reduction and it can be only assumed that the assistance provided has an indirect impact on GHG emissions reductions. For example, construction of good and very good roads results in reduction of up to 20% of fuel consumption and thus, to reduction of CO_2 emissions.

7.2.3.3. Global Environmental Facility

The Global Environmental Facility (GEF), the UNFCC's financial mechanism, is a multilateral key institution for environmental technologies transfer. The GEF aims to promote GHG emissions reduction actions by removing the long-term barriers, implementation and technological costs. An important objective of these programmes is to catalyze sustainable markets and create an enabling environment for technology transfer.

GEF projects are geared toward testing and demonstrating the variety of institutional models and funding towards promoting the technologies merger, some of the GEF projects being designed towards mobilizing private sector financing. Capacity building is a central element of the GEF projects, which has a direct impact on the host countries' capacities to understand, absorb and disseminate technologies.

Since 1991, over the course of 25 years of activity, the GEF has granted to developing and countries with economies in transition, about US$14.5 billion in grants and US$75.4 billion as co-financing for almost 4000 projects in 167 countries. Through the Small Grants Program (SGP), GEF provided more than 16 030 small grants directly to civil society and community organizations, totaling US$ 653.2 million[53].

Since the Republic of Moldova joined GEF and applied for grants, the country has obtained a non-reimbursable financial support amounting to USD 165.05 million and USD 446.59 million in the form of co-financing for 41 projects, including 11 projects on climate change[54].

Also, the Republic of Moldova participated in 16 regional and global GEF-funded projects totaling to US$ 129.2 million, and US$ 318.9 million were earmarked for co-financing, including the development of the Intended National Determined Contribution to the Paris Agreement (COP 21) under the United Nations Framework Convention on Climate Change (UNFCCC)[55].

In the last operational phase of applying for GEF funding (GEF-6) for the period July 2014 - June 2018, the Republic of Moldova received an offer to develop and implement projects worth $1.5 million in the field of biodiversity protection, US$ 2.0 million for climate change (US$ 3.219 million have already been used), and US$ 5.5 million for combating soil degradation (US$ 3.3 million have already been used). The application for GEF-7 is in progress[56].

Also, the Republic of Moldova joined the Small Grants Programme promoted by the Global Environmental Facility. Launched in 1992, in Moldova the SGP was initiated in the end of 2012. During 2012-2015 the Operational Phase 5 (OP5) was implemented, which included 12 projects promoted by NGOs in the areas stipulated in the country strategy paper: biodiversity, climate change, water and chemicals. Projects have included capacity building activities for the stakeholders in the process of overcoming environmental problems worldwide – the GEF priorities.

Projects supported by OP5 contributed to the improvement of the quality of cross-border waters, reducing GHG emissions and elimination of the causes of biodiversity loss and to promoting its conservation. Under OP5 about US$ 478 600 were awarded as small grants for public associations, the total number of beneficiaries being 116 470 persons, of which 734 women. Public associations, implementing projects have managed to attract co-financing worth US$ 580 694, including US$ 172 606 as in-kind contribution. Because of implemented projects, the RM has managed to prevent generation of 192.8 tons of CO_2 annually, using 14 kinds of innovations and develop 3 local policies in the field of environmental protection. The listed results are not the same with the final ones, given that four projects financed by OP5 will be finalized by the end of December 2017[57].

The maximum value of a grant awarded is US$ 50 thousand. The project should provide co-financing of at least 50% of the total value of the project.

[52] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=360497>

[53] <http://www.undp.md/media/tender_supportdoc/2013/645/Strategia%20Nationala%20a%20Programului%20de%20Granturi%20Mici.pdf>.

[54] <http://www.thegef.org/country/moldova>

[55] <http://www.thegef.org/country/moldova>

[56] <http://www.thegef.org/country/moldova>

[57] <http://sgpmoldova.org/files/SGP%20OP6%20CPS%20Moldova%20EN%20approved.pdf>

It is also important to emphasize that, in recent years, several already completed projects have created a basis for implementation of new projects, supported by the GEF SGP. Among these, the following can be mentioned: Improving the Soil Layer and Efficiency of Protected Areas Administration System in the Republic of Moldova, Climate in the Eastern Regions, Environmental Tax Reform in the Republic of Moldova, Rural Economic and Climate Resilience Program (FIDA VI), Energy and Biomass, implemented by the UNDP in the Republic of Moldova[58][57].

7.2.3.4. Multilateral Development Banks

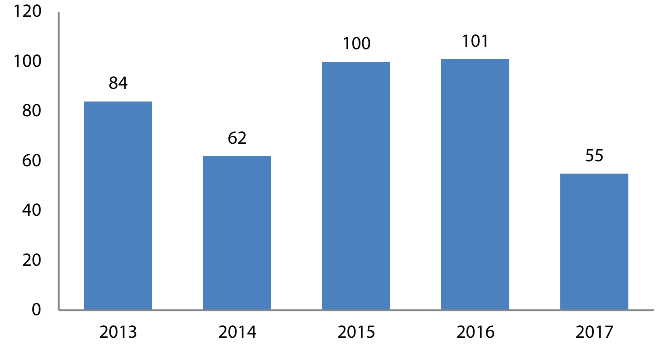
Multilateral Development Banks (MDB) considers technology transfer as part of their mission to encourage the development, including a cleaner environment. They have become aware of the role they might play toward raising capital to meet the needs of sustainable development and the environment, as well as the possibility of using financial innovation to encourage environmental projects and initiatives. The multilateral development banks that proved out particularly in promotion of sustainable development projects in the Republic of Moldova are the World Bank (WB) and the European Bank for Reconstruction and Development (EBRD).

World Bank Group (IBRD, IDA, IFC, MIGA, ICSID)

The Republic of Moldova joined the IBRD on 12 August 1992, the day considered the official date in which the country became a member of the World Bank. The International Development Association (IDA) grants loans with low interest rates or no-interest rate - called loans, and grants to poorer countries. The Republic of Moldova became a member of the IDA on 14 June 1994. The International Finance Corporation (IFC) provides loans, capital lending and technical assistance to encourage private sector investments in developing countries. The Republic of Moldova became a member of the IFC on 10 March 1995. The Multilateral Investments Guarantee Agency (MIGA) provides guarantees against losses due to non-commercial risks incurred by investors in developing countries. The Republic of Moldova became a member of MIGA on June 9, 1993. International Centre for Settlement of Investments Disputes (ICSID) provides facilities for international reconciliation and arbitration of investment disputes. The Republic of Moldova became a member of ICSID on 4 June 2011.

Since 1992 until 2016, the World Bank provided about US$ 1.4 billion[59] for 97 projects in the RM. The current World Bank Group Partnership Strategy includes financial commitments totaling to US$ 318 million for fiscal years 2014-2017. According to the Strategy, assistance will be provided on the three main pillars, including "Promoting Green, Clean and Resilient Green Moldova" by: (i) enhancing climate change adaptation and resilience; (ii) improving the management of natural resources; and (iii) enhancing energy efficiency and security[60]. A breakdown of the loan amount over the loan lifetime is shown in Figure 7-5.

The financial support that came from the WB to date has been granted in areas such as health, education, agriculture, energy, water supply and sewerage systems, e-Government, social protection, competitiveness, and more.



Source: World Bank. The amounts include commitments IBRD and IDA.

Figure 7-5: The WB commitments for annual lending, mil. US$

The World Bank's technical assistance (TA) products will be useful in promoting structural reforms and development of a new economic growth instrument for Moldova based not only on remittances, but also on exports and investment. Work continues in the area of food security, the future ESATA will include tax programmatic activities, activities further A&A ROSC, continuation of activities in competition and structural reforms, and TA in healthcare. Specific analysis might be performed to complement the proposed lending program in energy, education, streamline the DCFTA development in agriculture. ESATA in the financial sector could include actions to improve remittance mediation, financial sector monitoring to support crisis resilience and market development[61].

WB projects with GHG mitigation impact over the past 10 years in the RM are listed in Table 7-2.

The biggest environmental problems of the Republic of Moldova are: soil degradation, surface water pollution, lack of sustainable waste management (solid and liquid), and increased groundwater pollution caused by poor management of manure in rural communities. The Republic of Moldova has made substantial progress in the field of environmental protection. At the same time, projects have been successfully implemented to stop and reverse soil degradation while providing global benefits such as the planned reduction in CO_2 emissions in the years to come.

The largest project supported by the World Bank is the Energy Efficiency Project II (IDA credit of US$45 million, 2003-2012), which ended in April 2012, aimed at improving the security and reliability of the power transmission system and electricity supply and, therefore, facilitation of free commercial operations of the energy system and heat supply efficiency in certain public buildings (schools, hospitals, etc.). Another project focused on the energy sector was launched in 2011 for the heating system of Chisinau municipality, and is still ongoing. Aiming at effective implementation of the project, in November 2014 the World Bank allocated US$40.5 million with further increase of this amount up to US$61.1 million until 2020. The project will ensure energy savings of circa 2.8 billion kWh, with evident GHG emissions reduction[62].

[58]

[59] <http://web.worldbank.org/WBSITE/EXTERNAL/PROJECTS/0,,pagePK:64392398~piPK:64392037~theSitePK:40941~countrycode:MD~menuPK:64820000,00.html

[60] <http://www.worldbank.org/ro/country/moldova/projects>

[61] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=653>.

[62] http://projects.worldbank.org/P132443/district-heating-efficiency-improvement-project?lang=en&tab=overview

Table 7-2: WB projects with GHG mitigation impact in the RM

No.	Project Name	Employee loan, US$ millions	Approved Date
1.	The agriculture competitiveness project (WB), the second additional financing	10.00	07.07.16
2.	Rehabilitation of local roads	80.00	30.10.15
3.	The agriculture competitiveness project (WB), additional financing	12.00	19.05.15
4.	The efficiency of district heating system	40.50	21.11.14
5.	Emergency support in agriculture	10.00	14.05.13
6.	The agriculture competitiveness project (WB)	18.00	01.05.12
7.	agriculture competitiveness project (GEF)	4.44	01.05.12
8.	Production of biogas from livestock waste, pilot project	0.98	24.06.11
9.	Moldova: SIDA Trust Fund towards financing energy reforms and increase energy efficiency	2.87	17.02.11
10.	Community forestry project in Moldova	2.00	26.05.09
11.	Energy project, additional financing	10.00	29.01.09
12.	Environmental infrastructure project	4.56	29.05.07
13.	Support project for the Road Sector Program	16.00	29.03.07
14.	Soil conservation project	2.48	16.06.06
15.	Energy conservation and emission reduction (Community Development Carbon Fund)	0.48	24.02.06
16.	Public biomass-based heating in the rural sector (Facilitating Community Development Carbon Fund)	1.49	24.02.06
TOTAL		**215.80**	

European Bank for Reconstruction and Development

The European Bank for Reconstruction and Development (EBRD) has 67 shareholders, 65 countries and two international organizations.

Current projects launched by the EBRD for the RM by areas are as follows:

- Business (agriculture, manufacturing and services, property, telecommunications and tourism) - 9%,
- Energy (electricity and natural resources) -13%,
- Financial sector (SME support) - 9%,
- Infrastructure (environnement and municipal transport) - 69%.

Assistance provided to the Republic of Moldova in January 1991 – January 2017 covered a total of 115 projects with a total value of 1,183 million euro, of which the gross amount of disbursements is worth 640 million euro, and the private sector portfolio is 21%. Currently there are 45 ongoing projects worth of 485 million euro, funded by the EBRD[63].

Over the past 10 years the EBRD projects with direct impact on the direct GHG emissions mitigation in Moldova are presented in Table 7-3.

[63] <http://www.ebrd.com/where-we-are/moldova/data.html>

Table 7-3: The EBRD projects/loans with impact on direct GHG emissions mitigation in the Republic of Moldova

No.	Title loan (project)	Employee loan, US$ millions	Approved Date
1	Chisinau buildings within the Green city	10.7 (EIB) + 5 (Donors) + 15 (other sources)	14.09.16
2	The district heating system, Balti	10.7 (EBRD, E5P)	17.04.14
3	Moldova road rehabilitation IV	150.00	26.03.13
4	The rehabilitation of the railways of Moldova	25.00	16.10.13
5	Sustainable energy financing facility (MoSEFF and MoSEFF)	42.00	09.05.12
6	Sustainable energy financing facility in the rural sector of Moldova (MoREFF)	35,00	09.05.12
7	Transmission system rehabilitation Moldelectrica	21.50	09.05.12
8	Rehabilitation of the road sector of Chisinau	11.40	22.11.11
9	Roads rehabilitation Moldova III	75.00	26.10.10
10	Moldova roads rehabilitation project	30.00	27.06.07
	TOTAL	**411.30**	

Among the projects/loans mentioned above, the most significant impact on the direct GHG emissions reduction is expected to be produced by MoSEFF[64] and MoREEFF credit lines and Balti heating system. As a rule, reduction of energy consumption under the projects financed by these credit lines is above 30%, with the corresponding impact on GHG emissions mitigation.

To make investments in energy efficiency projects more attractive, MoSEFF offers grants for eligible projects. Depending on the energy savings and direct GHG emissions reduction achieved, grant component can be from 5 to 20% of the loan amount.

Among the companies well known in the Republic of Moldova, which have implemented MoSEFF- supported projects are Orhei-Vit, Macon, Ungheni and others. Also, a number of small companies, have implemented projects with loans from 10 000 to 2.5 million euro. To facilitate and accelerate investments in energy efficiency, the MoSEFF team provides technical assistance and recommendations for optimizing energy consumption. MoSEFF technical assistance is funded by the EU and is free of charge for eligible projects. MoREEFF program provides loans for implementation of energy-efficient technologies in houses. To help tenants and owners of dwelling premises in the country to reduce energy consumption, the European Bank for Reconstruction and Development (EBRD) has set up the facility for financing energy efficiency in the residential sector in Moldova (MoREEFF).

This Financing Facility provides credit lines to Moldovan banks intended to facilitate lending for energy efficiency projects in residential sector of Moldova. The beneficiaries of

[64] <http://www.moseff.org/>.

the loans can be the owners and tenants of dwelling spaces, Associations of housing owners, Housing Management Companies, Energy Service Companies and other eligible companies that provide maintenance, repairs, renovation, construction and operation services on the basis of contracts signed with the owners / tenants and pursue implementation of projects. Eligible projects include the following works: installation of energy efficient windows; walls, floors and roofs insulation; installation of energy biomass-based boilers, solar water heaters, gas boilers; heat pump systems, photovoltaic systems, including the architecturally integrated ones, heat exchangers and engineering systems.

Three sources of impacts are expected from the implementation of this project:

- Demonstration and market expansion effect:

The project will generate a transition impact by demonstrating the benefits of energy conservation and promoting the extension of lending for energy efficiency to the sectors in which cannot benefit of commercial lending, and in a country characterized by inefficient energy economy and largely limited market. In addition, MoREEFF opens the window for financing lodgers associations / condominiums, as well as legal persons (ESCO, services companies) for residential energy efficiency projects.

- Transfer of competences:

It is expected that the project will transfer and develop expertise and competition on many levels: (i) between participating banks, (ii) between borrowers and local experts and technology providers. MoREEFF will contribute to: increasing the stakeholders' awareness, market capacity building. The project will support legislative changes geared toward energy efficiency of buildings and regulation relating to housing.

- Transfer of technology:

Loans and credits are allocated on condition that advanced technologies are promoted and reflected in the respective technology lists[65]. These are: windows, thermal insulation, heat pumps, biomass boilers and stoves, solar water heaters, gas water heaters, photovoltaic systems, etc.

7.2.3.5. Clean Development Mechanism of the Kyoto Protocol

In order to promote the projects eligible under the Clean Development Mechanism (CDM), the Designated National Authority (DNA) for Clean Development Mechanism of the Kyoto Protocol was established. Its activity is regulated by the Government Decision no. 1574 of 26.12.2003[66].

It should be noted, that the Kyoto Protocol has expired in 2012, but by the decision of the 18th Conference of the Parties to the UNFCC, in December 2012 in Doha, Qatar, the term of the Kyoto Protocol was extended for eight more years. Thus, the mechanisms of the Protocol will continue to exert influence, both on the technology transfer, and serve as the major tools to achieving the objective of direct GHG emissions reduction globally.

Until now several CDM projects have been initiated in the Republic of Moldova, which are reflected in Table 7-4. Implementation of these projects is expected to result in GHG emission reductions equivalent to about 1.5 million tons of CO_2 annually.

The total amount of Certified emission reductions (CERs) issued by the CDM Board prior to 01.02.2017 under the CDM projects registered in the RM is 1 304 779 t CO_2 equivalent[67] (Table 7-4).

Aiming at facilitating CDM projects related to reducing consumption of electricity produced from fossil fuels, with the World Bank financial support, the calculation tool was developed in 2011, to calculate the Grid Emission Factor for the National Power System (GEFS), and concrete GEFS values were calculated for the credit periods that started in 2010[68].

[65] <http://moreeff.info/tehnologii/>.
[66] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=299618>
[67] <https://cdm.unfccc.int/Projects/projsearch.html (click "Database for Step and PoAs")>
[68] <http://clima.md/lib.php?l=ro&idc=243&>.

Table 7-4: CDM Project implemented in the Republic of Moldova

The DNA data of approval	Registration project title	GHG emission reduction planned, t CO_2 eq./year	Total CERs issued by 01.02.2017, t CO_2 eq.	Project status
07.02.2012	Reducing gas leakages within „Pridnestrivie-Tiraspoltransgaz" gas distribution network	164 043	0	Registered
20.12.2011	Reducing gas leakages within the Moldovagaz distribution network	748 903	0	Registered
17.03.2009	Moldova Community Forestry Development Project	94 354	328 809	Implementing
31.07.2006	Biogas production from pressed sugar beet pulp Südzucker Moldova, sugar refinery Drochia	21 142	0	Registered
31.07.2006	Construction of Combined Heat and Power Plant (CHPP) at Tirotex', Tiraspol	62 000	0	In the process of registration
19.07.2006	Landfill Gas Recovery and Energy Production at the Tintareni Landfill Site, Chisinau	248 560	0	In the process of registration
30.09.2005	Moldova Biomass Heating in Rural Communities (Project Design Document No. 2)	19 026	36 658	Implementing
01.10.2005	Moldova Biomass Heating in Rural Communities (Project Design Document No. 1)	7 316	43 062	Credit period ended
02.10.2005	Moldova Energy Conservation and Greenhouse Gases Emissions Reduction	10 934	44 339	Credit period ended
09.09.2004	Moldova Soil Conservation Project	179 242	851 911	Implementing
TOTAL		**1 555 520**	**1 304 779**	

Thanks to additionality criteria applied under the CDM projects (for instance, the projects are eligible if they are not economically feasible without carbon sale, the technology applied is a new one for the country, etc.) it was possible to transfer technologies that ordinarily would not have been implemented in the RM in the respective years. All projects mentioned above are part of this category.

CHAPTER 8: RESEARCH AND SYSTEMATIC OBSERVATION

CHAPTER 8: RESEARCH AND SYSTEMATIC OBSERVATION

8.1. Institutions Involved in Systematic Observations

According to the Law "On Hydrometeorological Activity" of 25.02.1998, the hydrometeorological activity in the Republic of Moldova is carried out by the State Hydrometeorological Service (SHS). SHS is a public institution subordinated to the MARDE, the activity of which is regulated by the Government Decision no. 401 of 3 April 2003 "On some aspects of hydrometeorological activity in the Republic of Moldova".

SHS administration is ensured by its Director, appointed by the Government. The current organizational formula of the SHS comprised three main fields of activity: meteorology, hydrology and environmental quality monitoring. The SHS's Director is backed up by the first Deputy Director and a Deputy Director, both appointed and dismissed by the MARDE. The supreme body governing the SHS is the Technical and Scientific Council, headed by the SHS's Director.

The main tasks of the SHS are:

1. To monitor the state and evolution of the hydrometeorological conditions and environment quality with the purpose to protect the population and national economy against dangerous hydro-meteorological phenomena and high levels of environmental;
2. Develop meteorological, agro-meteorological, hydrological forecasts, as well as environmental pollution forecasts;
3. To issue warnings on imminence of hydrometeorological hazardous phenomena, as well as on high levels of environmental pollution;
4. To provide hydro-meteorological and environmental quality information to the population, central and local public authorities, businesses, national defense;
5. To establish and operate the National Hydrometeorological Data Fund to support hydro-meteorological justification for design, construction and exploitation of various socio-economic objects and to develop long term national economy development strategies;
6. To participate in the international data exchange within the global hydrometeorological observation system and to fulfill the commitments under the conventions and international agreements to which the Republic of Moldova is a party.

The history of the SHS begins with the first meteorological observations carried out in Chisinau in 1844. Thirty years later the first hydrological post was organized on the Nistru River in Tighina (1878). In the same period meteorological observations were started in five locations of the country: Briceni (1887), Soroca (1890), Comrat (1892), Ploti (1894) and Tiraspol (1898). At the beginning of the XX century stationary meteorological observations were carried out at 11 meteorological posts and 6 hydrological posts. However, at most stations and posts the observations were not carried out regularly, being interrupted by the First and Second World Wars. In October 1944, the Hydrometeorological Department of the Republic of Moldova was established which ensured further planned development of regular hydro-meteorological observations in the country. In the same year, the Meteorology Office, comprising hydrological and meteorological forecasting groups was established within the Department. The Meteorological Office carried out a vast activity on assessing the methodology used by the Central Forecasting Institute (Moscow) and adapting it to the conditions of the RM, as well as developed new methodologies. The Hydrological Forecasting Group has developed methods of hydrological forecasting for the Prut and Dniester rivers. The first rain flood forecast was issued in 1950 and the first rain flood discharge forecast was issued in 1953. During the post-war period the reconstruction of the old stations started, new stations have been established and new types of observation have been developed. In 1946 the first aerial survey was carried out in Chisinau. For a long period of time atmospheric sounding was made occasionally, but since the Upper-Air Station was opened in Chisinau in 1957, this process became regular.

In 1953 the Hydrological Balance Station was established and in 1957 the Hydrological Station in Dubasari basin was opened. In 1954 observations on the radiation balance components have started. For agricultural needs ensuring purposes the agro-meteorological observation network has been extended, particularly to determine available soil moisture (from 3 posts in 1947 to 24 posts in 1963). In mid-50 years of the XX century the hydrometeorological network has reached its optimal allocation density through the entire territory of the Republic of Moldova.

The development of hydrometeorological network required continuous methodical guidance and a series of publications with generalized hydrometeorological data were developed. For this purpose the Hydrometeorological Observatory was established in 1956 (reorganized into Hydrometeorological Centre in 1982) which ensured methodical guidance for the observation network, provision of equipment, developed new types of observation, summarized hydrometeorological data in monthly reports, yearbooks and guidelines, and carried out scientific research. Atmospheric air pollution monitoring in the RM started in 1950, by carrying out the studies on hydrochemical regime of two rivers at 5 posts. At present the work content of these activities has considerably increased. Observations are taken at 32 posts on 13 rivers by 42 sections, and in water 3 basins by 45 indicators. Since 1976 the surface water quality control by 5 hydrobiological indicators has been carried out. Observations on air pollution started in 1969 in Chisinau at 3 stationary posts by 4 indicators and have gradually extended in terms of observation posts, and observed components. At present such observations are carried out by 7 components in stationary posts in 4 towns of the country. Also, air pollution forecasts are issued since 1979. Use of chemicals in agriculture preconditioned the need for soil quality monitoring and pesticide control. The monitoring began in 1976 with establishment of the soil pollution monitoring laboratories which nowadays make analyses for all areas across the country where chemicals are used.

With the independence of the Republic of Moldova, SHS becomes independent as well. In accordance with the Resolution of the Parliament of the Republic of Moldova of 29 July 1994, the State Hydrometeorological Service is a member of the World Meteorological Organization (WMO). Since 2001, a prospective plan has been developed providing for the development and enhancement of the SHS potential. To achieve this goal, with the financial support of the Government and National Ecological Fund, important activities aimed at modernization and streamlining the SHS main production subdivisions, including the National Observation Network, were carried out. Automatic weather stations for all meteorological posts, up-to-date equipment for hydrological and hydrochemical posts have been procured and installed.

8.2. National Systematic Observation System and Monitoring Network

According to the Law no. 1536-XIII of 25.02.1998 on hydrometeorological activity[69], systematic climate observations on the territory of the Republic of Moldova are carried out by the State Hidrometeorological Service of the Ministry of Agriculture, Regional Development and Environment. The SHS responsibilities include systematic observations of the climate and the environment conditions under the influence of natural and anthropogenic factors.

The National Meteorological System reproduces, on a country-wide level, the global meteorological system. It is of a complex nature and ensures recording, transmission and processing of meteorological information, according to internal needs, directives and agreements of the World Meteorological Organization and other bilateral treaties and conventions to which RM is a party.

Systematic climate observations are the main source of activity data for scientific analysis of climate and climate change.

The SHS terrestrial monitoring network includes approximately 90 hydrometeorological stations and posts and checkpoints to monitor air, water and soil pollution. Observation of meteorological, hydrological and agro-meteorological parameters and ecologic monitoring is carried out in a non-stop regime at stations and posts. The permanent observation points form the network and are equipped with the same type of equipment and operate in in accordance with the international classical method. The placement of hydro-meteorological stations and posts on the territory of the RM is in line with the international requirements contained in the WMO's Global Observation System Manual.

At present, the number of weather stations located on the territory of the country is close to optimal density and is in line with international standards. At the same time, taking into account that the Republic of Moldova is considered to be a region with a high risk of heavy shocks, the density of the meteorological network is considered to be slightly below the optimum limit.

The information obtained from monitoring is used for meteorological, agro-meteorological and for air, water and soil pollution assessments, for warning on hydrometeorological disaster phenomena, for the global and regional exchange of hydrometeorological data, for the assessment of the climate change in the RM, and for supplementing the National Hydrometeorological Database.

8.2.1. National Monitoring System

The SHS meteorological observation network includes 18 meteorological stations 15 agro-meteorological stations and 32 weather mini-stations (Figure 8-1).

The results of meteorological observations received at stations in accordance with the WMO Guidelines include more than 80 measurements, recordings and visual features of different meteorological dimensions. They form the basis of meteorological data banks of all types and destinations, are used for development of hydro-meteorological forecasts, providing consumers with the information on actual meteorological observations in the observation points, notifications and warnings on dangerous phenomena and natural disasters, as well as for describing the local meteorological regime and climate.

In 2004-2008, the Vaisala semi-automatic stations (soft SAIM "Pogoda") were installed at 14 weather stations. The SAIM "Pogoda" stations allow to measure air temperature and humidity, atmospheric pressure, wind speed and direction, soil temperature up to 5 cm depth, and to promptly transmit the operational information in non-stop automatic mode. Other meteorological parameters are measured by using classical equipment. The 4 stations on the left bank of the Dniester river (UATSN) carry out climate monitoring using classical equipment.

In 2016 of the national meteorological network was modernized. New automated weather stations (ADASA, Spain) have been installed at 14 weather stations, measuring all the basic meteorological characteristics, as well as the amount of precipitation.

Actinometric observations (direct, diffuse and summary solar radiation, radiation balance and the underlying surface albedo) are carried out at the meteorological station in Chisinau.

In 2016 the automatic actinometric complex was installed to measure all solar radiation components.

In 2016, in different districts of the country 32 automatic weather stations were installed, measuring air temperature and humidity, the temperature of the soil at a depth of 5 cm. as well as the amount of rainfall.

Every three hours the basic meteorological information, encoded in SYNOP telegrams, is collected by the Communication and Information Technology Centre. These data are submitted to the Regional Meteorological Centre (Moscow, Russia) to be distributed within the global and regional exchange among the WMO member countries. Monthly meteorological information obtained at the four stations and encoded in "Climate" telegrams is transmitted to the Regional Meteorological Centre (Moscow, Russian Federation), DWD (Germany) and World Climate Data Centre (Asheville, North Carolina, USA). These data are further used by the WMO to prepare monthly climatologic reports and climate modeling in relevant scientific research.

[69] The Law of the Republic of Moldova on the hydro-meteorological activity No. 1536-XIII of 25.02.98 Official Gazette of the RM no.60-61 of 02.07.1998

Information on the occurrence of dangerous meteorological phenomena or natural disasters, encoded as "WAREP", is promptly transmitted through the Telecommunications and Information Technologies Centre (Chisinau) to the Meteorological Forecasting Centers at all the stations.

The global observations network (GCOS) includes Chisinau weather station, its data being used for global information exchange. At regional level data from all stations of the national network are used.

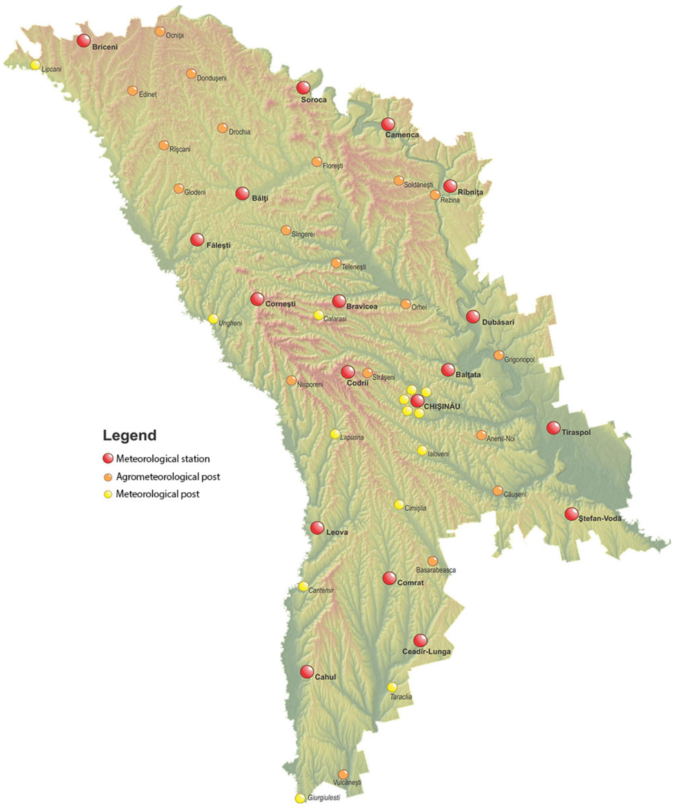


Figure 8-1: The Meteorological Observation Network of the SHS of the RM.

Data on adverse meteorological phenomena observed across the country each year are transmitted and included in the WMO's Bulletin for Region VI.

In November 2010, as part of the regional EUMETSAT Project, the National Meteorological Forecasting Centre has been equipped with the DAWBEE station receiving and visualizing data by satellite, which allows to monitor the state of the atmosphere, evolution of cloud systems, parameters of moisture fields, meteorological phenomena, etc. in quasi real time.

In 2010 the implementation of "Disaster and Climate Risk Management in Moldova" project, financially supported by the World Bank, started. A series of activities on modernization of the existing hydro-meteorological monitoring system of the SHS were carried out under the project.

In 2013 the Doppler weather radar system with dual polarization has been installed and put into operation. The SHS has a modern laboratory for equipment calibration.

In 2016, the installation of the Data Processing, Processing, Editing and Automated Data Production System was completed in the SYNERGIE and METEOFACTORY forecasting process together with Meteo France International.

Through the UNDP Project "Supporting Moldova's National Climate Change Adaptation Planning Process" and the partnership with colleagues from ZAMG (Institute of Meteorology and Geodynamics in Austria), SHS became a member of the EUMETNET (EMMA / METEOALARM and OPERA) as of 1 January 2016.

8.2.2. Climate Database

SHS continuously builds its climate database. Also, the National Hydrometeorological Data Fund stores historical data of meteorological observations (since 1886). These data are used to analyze weather patterns across the country and to estimate climate evolution over the period of instrumental observations.

The climate database generated from meteorological observations contains the following parameters:

- atmospheric pressure (at the station and sea level);
- air temperature (average, maximal, minimal);
- air humidity (partial pressure, relative humidity, dew point deficit);
- wind (direction and speed);
- meteorological visibility;
- precipitations;
- nebulosity (clouds type and height);
- soil surface temperature (average, maximal, minimal);
- soil temperature at depth on vegetation free sector (at 5, 10, 15 and 20 cm depth);
- soil temperature at depth on vegetation covered sector (at 20, 40, 80, 120, 160, 240 and 320 cm depth);
- snow layer (height, density, water content);
- atmospheric phenomena.

Meteorological data is processed by „PERSONA MIS" and „PERSONA MIP" software that allow to process information in accordance with the WMO's recommendations and requirements. Climate database is built by using the "CLICOM" climate data processing system. The climate database is built by using the CLICOM Climate Data Processing System. Weather data from the new automated stations (ADASA, Spain) is automatically systematized as TMS tables (weather stations tables), TMP (Weather Station Table) tables, and also as monthly meteorological reports.

The National Hydrometeorological Data Fund is systematized and permanently supplemented with hydrometeorological observations data and relevant scientific research materials.

The main tasks of the National Hydrometeorological Fund are:

- collect, maintain, organize and keep record of observation and hydrometeorological research materials, including departmental organizations data, both from the RM and abroad;
- carry out state registration of departmental hydrometeorological stations and posts;
- develop, based on hydrometeorological observations data, registers, catalogues, guidelines relevant to the SHS activity.

8.2.3. Data Collection System

The following types of communication are used to collect data from the observation network and receive synoptic information:

- internet (data from meteorological stations), at 14 out of 18 stations 3G modems ensuring a speed of 4.7 Mb/s are installed;
- since 2016 data from the new meteorological stations are transmitted directly (via GSM) to the server installed in SHS (Chisinau);
- telegraph (data from stations) – "Telex Alpha" telegraph modem and the corresponding software is installed at Telecommunication Centre; this set fully replaces the telegraph and allows to receive the telegram directly on the computer, with subsequent possibility of editing it;
- telephone (in case of other communication means failure);
- a complex meteorological multi-satellite "MITRA", connected to a satellite communication channel that allows to receive satellite images, maps, data distributed in the form of a meteo-message, as well as operational information;
- a direct channel for transmitting information from the Doppler DWSR-3501C meteorological radar, located on the territory of Chisinau international airport;
- direct channel to the Regional Meteorological Centre of the World Meteorological Organization (Moscow), using the designed "UniMas" hardware and software set intended to perform the message switching function; "UniMas" receives – transmits meteorological data through a direct link channel.

Also, the SHS specialists have designed and developed a website <www.meteo.md>, which contains data about current weather, agro-meteorological, hydrometeorological and weather forecasts, different maps, satellite images and other meteorological and hydrological information as well as information on environmental quality.

In 2017, under the UNDP Project "Supporting Moldova's National Climate Change Adaptation Planning Process" and in partnership with ZAMG colleagues, the SHS website <http://www.meteo.md> was renovated and upgraded.

8.2.4. Hydrological Monitoring System

The State Hydrometeorological Service carries out hydrological monitoring of surface waters.

The National Hydrological Monitoring Network (NHMN) of surface water consists of two stations (Ungheni and Ustia stations) and 54 hydrological posts, 31 in the Dniester River basin, 24 in the Prut River, the Danube and the Black Sea basins (Figure 8-2).

Daily observations of water level, rainfall, water and air temperature, water turbidity, seasonal observations of ice formation phenomena, ice thickness, measurements of water flow are carried out at hydrological posts. Special programs provide for studies on regional characteristics of the hydrologic regime of water bodies, identification of zonal factors and economic activity impact, development and spreading of the natural hydrological hazardous phenomena, taking into account assurance of national economic organizations.

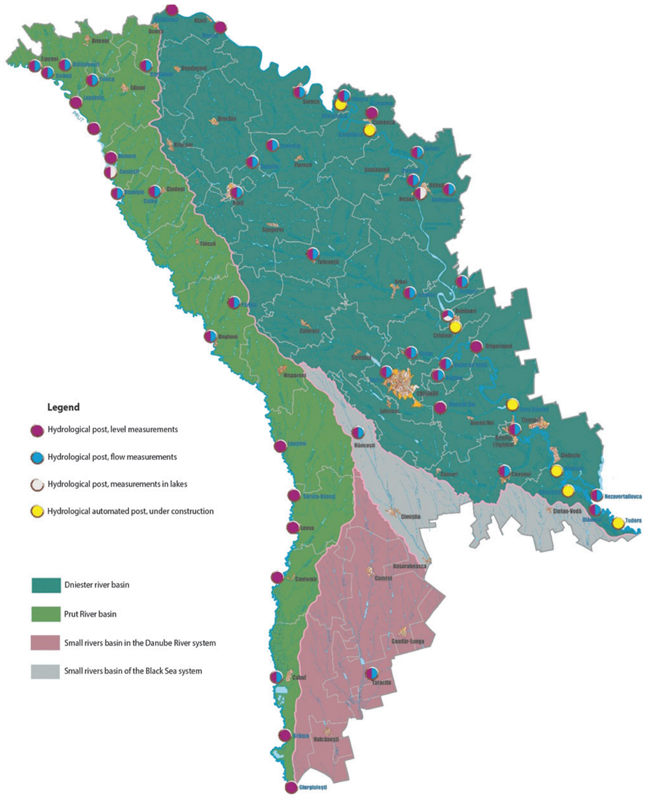


Figure 8-2: Hydrological Observations Network of the SHS of the RM.

The NHMN provides the information needed to make operational decisions on preventing dangerous hydrological phenomena, water management, as well as development of the river basins management plan. The NHMN supports the provision of coherent and operational hydrological data for the development of hydrological forecasts, as well as the annual data needed for the development of the Hydrological Directory.

In 2006-2008, supported by the Government of the Czech Republic the "Surface Water Monitoring and Flood Prevention on the River Raut" project was implemented. Five automatic hydrologic stations were installed under this project. In 2010-2012, with the support of the Government of the Czech Republic 11 automatic hydrologic stations were installed on the river Prut. In 2011, the SHS installed a web server that receives data from automatic hydrologic stations using GPRS and satellite communications. In 2013, the Millennium Challenge Corporation Project "Irrigation Sector Reform" created an automated system of monitoring water resources in the Dniester river basin - eight automatic hydrologic stations were installed. In 2014, under the project "Climate Risks and Disaster Management in Moldova" eight automatic hydrologic stations were installed in the Dniester river basin.

Systematic hydro-meteorological observations carried out on the territory of the RM over the 50-100 years, allowed to summarize hydrologic data and publish it in hydrologic guidebooks and scientific monographs such as: "Hydrological Yearbook", "Multiannual data on resources and the surface waters regime", "The State Waters Cadaster", which are used for planning and implementing the measures against the harmful influence of hazardous and risky phenomena, and for the environment protection.

Hydrological information is shared on a regional level between the Danube river basin (DANUBE-HYCOS) and Black Sea (BLACKSEA-HYCOS) states. Long-term intergovernmental agreements and programs with the neighboring countries, Ukraine and Romania, are of particular importance. These agreements and programs provide for sharing hydrologic operational information and monitoring of the state of water resources in the Dniester and Prut Border Rivers.

8.2.5. Environmental Quality Monitoring System

The Environmental Quality Monitoring Department of the SHS carries out systematic ecological monitoring of the quality of the environment components (surface water, air, soil, sediments, rainfall, ambiental dose rate of γ-radiation etc.) through the monitoring network covering the entire territory of the RM.

The national environmental quality monitoring system was established in the '60 of the XX century and systematic observations started in the '80 of the XX century, now having the following priority objectives: monitoring of the quality of the environment components and determining the level of pollution; detection of extremely high pollution of surface waters, air and soil; prevention and mitigation of adverse effects on the environment and population by using emergency warning systems; emergency warning of decision makers about level of environmental pollution; building systematic awareness of the civil society about the quality of the environment.

Currently the national monitoring system contributes to solving the most pressing issues related to the quality of the environment, mainstreaming the environmental aspects in the economic sectors and promotion of sustainable development. The Environmental Component Monitoring Network includes: 72 posts - surface water quality, 19 stations - monitoring of air pollution and radioactivity of the environment, 37 sections - soil monitoring (Figure 8-3).

The EQMD subdivisions operate under: the Convention for the Protection and Sustainable Use of the Danube River; the Stockholm Convention on Persistent Organic Pollutants; Convention on the Transboundary Effects of Industrial Accidents; Convention on Long-Range Transboundary Air Pollution as well as in accordance with the Bilateral Agreements for Cooperation with various organizations and institutions of the Republic of Moldova and the neighboring states.

The results are used in the equivalent information exchange with the neighboring countries and the member countries of the Danube Convention on Transboundary Watercourses Quality, and are periodically submitted to the secretariats of the Stockholm Convention on Persistent Organic Pollutants and the Convention on Long-Range Air Pollution, for preparation of monthly environmental quality bulletins on cases of high and extremely high pollution of environment components, newsletters and other types of updated information requested by beneficiaries

Development and management of the database on the state of the environment in the RM are needed for the decision-making process and defining of the environmental management strategy at all governance levels.

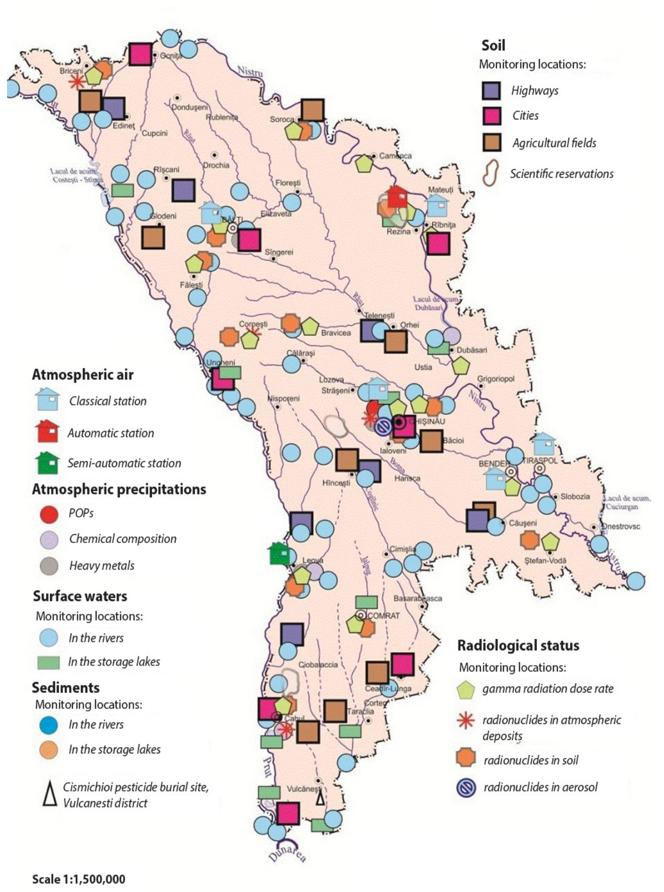


Figure 8-3: Environmental Components Monitoring Network.

8.2.6. Agroclimatic Monitoring System

Agro-meteorological monitoring is carried out by the State Hydrometeorological Service. Agro-meteorological monitoring is a system of observations of agro-meteorological conditions, soil condition and moisture reserves in the soil, the agricultural crops development and productivity rate. The operational information received serves as basis for the estimation of the weather conditions and their effect on the state and productivity of agricultural crops, modeling of the production process and projection of agricultural crops growth, development and yields, as well as development of agro-meteorological recommendations for making operational and optimal decision by agricultural producers.

At present agro-meteorological monitoring is done at 13 meteorological stations and 15 agro-meteorological posts in the Republic of Moldova.

At meteorological stations and agro-meteorological posts within the National Observation Network, observations are carried out by the following parameters: soil temperature in agricultural land; soil moisture up to a depth of 100 cm; observations and measurements on the soil condition and the snow layer during the cold period: depth of soil freezing, depth of soil thawing; observations on the thickness and density of the snow cover on agricultural cropland during the wintering period; agricultural crop development phases; determining crop production inputs and other. The State Hydrometeorological Service also monitors agro-climatic aridity.

Observations of complex meteorological elements are made at the same stations and posts.

In 2016 the agro-meteorological network was upgraded with new equipment for determining soil moisture (Delta-T).

The data collected as a result of agro-meteorological monitoring is used for the drafting agro-meteorological prognoses (future crop yields forecasts), for assessing the influence of meteorological conditions on the growth, development and formation of the crop yields during the vegetation period, the state of crops during the hibernation. The main crops (autumn wheat, corn, sunflower, sugar beet) yields are projected in advance from 1 to 3 months, which allows to assess the expected productive situation in the country in advance.

The agro-meteorological monitoring is performed to provide information to the Government, the National Bank, agricultural associations, farmers and others.

A series of publications reflecting different aspects of drought control (selection, physiology, etc.) are published with the contribution of the Field Crops Research Institute "Selection", the Institute of Ecology and Geography of the ASM, the Institute of Plants Genetics and Physiology of the ASM.

8.2.7. Other Types of Monitoring Carried out in the Republic of Moldova

Country wide monitoring of ground waters is carried out by the state enterprise "Hydro-Geological Expedition" subordinated to the Ministry of Agriculture, Regional Development and Environment. Monitoring includes measurement of ground waters level, temperature, and quality.

The Institute of Geology and Seismology of the ASM also implements research projects in hydrogeology, with ground water monitoring component included. Ground water monitoring results are published in the annual scientific bulletins, in which the analysis of information on changing the ground waters level and quality as a result of human activities and natural processes, is provided. The results of ground water quality monitoring are also transmitted to the State Geological Fund.

The national forest monitoring network of the Republic of Moldova was created within "Moldsilva" Agency.

The Institute of Soil Science, Agrochemistry and Soil Protection "N. Dimo" deals with research into soil genesis, geographical distribution of soils, soil classification across the country, development of soil mapping and land valuation methods, development of soils monitoring and inventory database, as well as research of soil erosion processes, development of erosion control technologies to reduce the degree of soil degradation, and other environmental aspects.

The Ministry of Health monitors air quality in urban areas. Measurements of maximum admissible concentrations in the air by six key parameters are made on a monthly basis.

Some of the institutes of the Academy of Sciences (e.g., Institute of Zoology, Botanical Garden (Institute), Institute of Genetics and Plant Physiology), the State University of Moldova and the Moldova State Agrarian University, study the flora and wild fauna of the country at species level.

8.3. Research Activity

Systematic hydrometeorological observations made in the RM over the past 60-110 years, allowed to summarize the climate data, and to publish it as climate and agro-climatic guidebooks, monographs, such as "Climate of the Moldavian Soviet Socialist Republic", "Climate of Chisinau", "Agro-Climatic Resources of the Moldavian Soviet Socialist Republic", "Agroclimatic Guidelines for the Moldavian Soviet Socialist Republic", "Natural Meteorological Phenomena in Ukraine and Moldova" and other which are used for planning and controlling harmful effects of dangerous natural phenomena, and environmental protection.

In climate research, special attention is paid to the study of complex adverse weather conditions. This is needed to successfully combat the negative effects of adverse weather conditions, identify solutions to environmental issues, and sustainable management of the environment.

The features of the adverse weather conditions vary by the objects which are affected by climate conditions. For example, agriculture is affected by frosts, droughts, hot winds, dust storms, the transport sector – heavy rains, sleet, slush, the constructions sector – by extremes temperatures, strong wind, heavy snowfalls and ice, etc.

The results of hydrologic observations are published in: "Annual data on the regime and surface water resources", "State Waters Cadaster of the Republic of Moldova", "Multiannual Characteristics Guide", etc.

Scientific research is also conducted under regional hydro-meteorological programs. Based on regional climate monitoring the carried-out research is focused on the natural and anthropogenic influence on the climate of the RM. Such research fosters climate change forecasts for the country; make it possible to calculate changes in the basic features of air temperature and precipitations. Risks and vulnerability for agricultural industries are assessed in the context of climate change, and adaptation measures for agriculture are identified.

It should be noted, that Research Centre and the GIS (RCGIS) of the SHS conducts research in hydro-meteorology and environmental quality monitoring, including to ensure the methodological and scientific support to the SHS subdivisions. The staffs of the Centre process and interpret meteorological, hydrological and environment quality monitoring related information, inclusively by using geographic information systems.

The RCGIS focuses on:

- development of scientific materials and methodologies in the SHS activity domains;
- development of scientific publications in the SHS activity domains;
- keeping record of new scientific and practical achievements in the GIS domain;
- mapping materials for forecasts development, analysis of certain hydro-meteorological actions or factors;
- mapping materials for the SHS web page;
- digital land use maps, updated on the basis of satellite images;
- spatial maps and different thematic maps;
- thematically dedicated GIS data bases;
- GIS info-planes derived products (surfaces of basins and sub-basins, median altitude of sub-basins, afforested areas, afforestation coefficient, etc.);

- altimetric digital model of land and derived products (slopes, expositions, altitudinal levels, topographic profiles etc.);
- floods, droughts hazard and risk maps, etc.;
- flood risk model in major large and small riverbeds;
- maps with delimitated areas affected by floods, droughts;
- estimates of water reserves in snow layers, volumetrically expressed as median water layer for basins of interest in terms of hydraulic energy and water supply;
- agro-meteorological and biophysical parameters of vegetal coverage derived from satellite date (soil surface temperature, actual evaporation, foliar index, biomass, spatial structure, vegetation indices, etc.);
- accidental pollution risk modeling in major riverbeds of large rivers;
- methodology guidance for use of GIS technologies in the spatial analysis of hydro-meteorological phenomena and processes and projections thereof.

Climate change modeling relevant for the territory of the country is carried out by the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment (for details see Chapter 5).

Other institutions involved in climate research, including modeling of future climate events, are the SHS and the Institute of Ecology and Geography of the ASM.

Research with reference to the influence of climate change on different sectors of the national economy are made periodically by the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment (for details see Chapter 5) and other organizations, such as the Institute of Plant Protection and Ecological Agriculture, Institute of Genetics and Plant Physiology, Field Crops Research Institute "Selectia", Institute of Soil Science, Agro-chemistry and Soil Protection "Nicolae Dimo", "Moldsilva" Agency, etc. For example, in 2013 the Institute of Ecology and Geography of the ASM published the "Atlas of Climate Resources of the Republic of Moldova" developed based on Geographical Information Systems (GIS) technologies.

8.4. International Cooperation in Hydro-meteorology and Climatology

International cooperation is essential for the development of meteorology, hydrology and environmental quality monitoring. It is impossible to carry out activities in these fields without international operational exchange of hydro-meteorological data and products, as well as information about the quality of the environment. In order to mainstream the principles of sustainable development into government policies and programs, the Republic of Moldova is making greater efforts to implement the provisions of the international conventions to which it is a part.

In its turn, the SHS gears its international activities along the following main directions:

- participation in the UN specialized agencies programs: World Meteorological Organization (WMO), UN Convention to Combat Desertification, United Nations Economic Commission for Europe Convention on the Transboundary Effects of Industrial Accidents;
- partnership within the Commonwealth of Independent States (CIS);
- implementation of bilateral agreements with other national meteorological, hydrological and environmental quality monitoring services;
- participation in scientific programs within international conventions and projects.

Collaboration with the national hydrometeorological services takes place in the framework of bilateral agreements. The relations with the hydro-meteorological services of the neighboring states develop at a more intense pace. The intergovernmental long-term cooperation programs with Ukraine and Romania are of special importance for strengthening the cooperation. These agreements and programs include sharing of operational hydro-meteorological information, the monitoring of the Nistru and Prut border rivers water resources status.

In 2006-2017, in collaboration with international partners, the SHS implemented the following projects:

- "Disaster and Climate Risk Management in Moldova" (2010-2016) project (supported by the World Bank);
- "Surface water monitoring and flood protection in the Prut river basin" (2010-2012) project (supported by the Government of the Czech Republic);
- EUMETSAT Project "Access to Data in the Western Balkans and Eastern Europe (DAWBEE)" (2010);
- "Surface water monitoring and flood protection in the Raut river basin" (2006-2008) project (with supported by the Government of the Czech Republic);
- UNDP / ADA Project "Supporting Moldova's National Climate Change Adaptation Planning Process" (2014-2017);
- The project "Building national capacities for primary response in the event of nuclear accidents / incidents that can cause environmental pollution" (2015) (supported by the Swedish Government)

International cooperation in the hydro-meteorological field is an important component in the operation of the SHS. International cooperation in the field of hydrometeorology is based on conventions and agreements to which the Republic of Moldova is a party.

In conformity with the Resolution of the Parliament No. 210-XIII of 29 July 1994, the Republic of Moldova has joined the World Meteorological Organization (WMO) and the SHS Director is the country's representative within this organization. The SHS specialists participate in the programs and projects of the CIS Interstate Hydrometeorological Council under the Cooperation Agreement on Hydrometeorology, signed by the Republic of Moldova on 8 February 1992; as well as other international programs (such as the UN Framework Convention on Climate Change, the Convention on Cooperation for the Protection and Sustainable Use of the Danube River, the Convention on Long-range Transboundary Air Pollution, the United Nations Convention to Combat Desertification).

The SHS is actively involved in the implementation of the World Climate Program, the World Program of Climate Applications and Services, the Program for Hydrology and Water Resources, organized under the World Meteorological Organization (WMO), as well as in the activity of the Intergovernmental Panel on Climate Change (IPCC).

CHAPTER 9: EDUCATION, TRAINING AND PUBLIC AWARENESS

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9.1. General Policy on Education

In accordance with the provisions of the Constitution of the Republic of Moldova, "everyone has the right to an environment which is not dangerous for life and health [...]"[70] (Article 37 (1) and, at the same time, "environmental protection, conservation and protection of historical and cultural monuments is an obligation of every citizen" (Article 59)[71]. However, in order to translate these provisions into real life, it is necessary to treat the relationship between man and the environment in terms of causes and effects of long-term actions. To ensure the successful development of the process, the education of the population in this area, in sustainable development, plays an essential role, especially in the context of the intense climate change of the last decade.

Ecological education, beyond the theoretical concept[72], involves the formation, from an early age, of an initial, basic and gradually, more advanced, understanding of the world that surrounds us and the way in which human activity may have a positive or a negative impact. Moreover, it focuses on creating a system of values and skills to identify environmental issues at the micro (local, national) and macro (global) levels, to actively participate in solving them to the extent possible (even through daily routine or habits) and, thus, to contribute to protecting, preserving and improving the condition of the environment.

Upon initialling and subsequent ratification of the Association Agreement between the Republic of Moldova and the European Union (2014), through which the country has undertaken to advance towards EU, the theme of environmental protection has become increasingly up-to-date. The need to align national legislation to the acquis communautaire has made it possible to increase the visibility of the subject. The main documents setting out the framework for such legal alignment are the "Environmental Strategy for 2014-2023" and "Action Plan for the Implementation of the Environmental Strategy for 2014-2023".

The third section of the third chapter of the "*Environmental Strategy for 2014-2023 and the Action Plan for its implementation*" (2014) highlights the importance of "environmental education and access to environmental information", but also points out gaps of the educational system in addressing this area and sets the objective and directions for action to limit and eliminate existing deficiencies. More specifically, according to the Strategy, by 2023, at least 50% improvement will occur in the knowledge of pupils, students and employees in environmental protection. The five steps proposed to achieve this goal briefly refer to the promotion and mainstreaming of ecological education in formal, non-formal and informal environments; education and training of teachers in attractive and productive educational methods that could conduct to effective lobbying for ecological education; developing the highly necessary methodology materials for teaching environmental protection; encouraging and developing research in sustainable development education and setting up a centralized (environmental) information system[73] by the competent authorities.

Educational System

As of 23.11.2014, the Law on Education Nr. 547 of 21.07.1995 was repealed and replaced by the Education Code (No. 152 of 17.07.2014). In the latter, we find that the education system is based on principles such as equity, quality, social inclusion, relevance, equality, etc. (Article 7)[74].

Among the relevant legal acts governing the education system in the Republic of Moldova are: "the Strategy for development of education for the years 2014-2020", "Education -2020", "the Program for development of inclusive education in the Republic of Moldova for years 2011-2020", "Strategy for development of vocational/technical education for the years 2013-2020", "Action Plan for restructuring the network of technical vocational education schools for the years 2016 - 2020".

In the following, issues related to ecological education and sustainable development (if available) will be highlighted at every stage of the Moldovan educational system (pre-school, primary and secondary general school, secondary vocational school, specialized secondary level, graduate and postgraduate levels).

I. Pre-School Education

The educational institution responsible for pre-school education (the nursery-kindergarten/kindergarten) has the task, together with the parents, to promote the multilateral progress of children in the first stage of adaptation to their new "status" (age 3-6/7) as member of a group and, as a whole, of the society. The learning process is influenced by the environment (socially, naturally) due to the discovery of the living world and the natural phenomena, but also due to outdoors activities. Many of the learning games (images, words, associations, etc.) target the environment.

II. Primary and Secondary General Education (Gymnasium and Lyceum)

Primary education (grades 1 to 4) and general secondary education (grades 5 to 9 and grades 10 to 12) is carried out annually according to a Framework Plan setting out the technical details of the school curriculum (such as structure of the academic year, the timetable, the mandatory and optional subjects, the number of hours allocated to each subject, etc.).

In both primary, secondary (gymnasium) school and in high school (lyceum) education, environmental protection is taught through a number of disciplines, such as "Science," "Biology," "Geography," "Chemistry." Education for sustainable development / ecological education exists as separate discipline as well (grades 1 to 12), but it is optional. There are also

[70] Constitution of the Republic of Moldova, State Register of Legal Acts of the Republic of Moldova, URL: http://lex.justice.md/document_rom.php?id=44B9F30E:7AC17731

[71] *Ibidem*

[72] Definition - „Attempt to convey a pragmatic way of thinking about ecosystems, species, populations, including human ones, as understood in their evolutionary context, in transformations that had occurred in space and time." in Andrei Isac, Iuliana Cantaragiu, *Evaluation Report. Promoting ecological education and sustainable development education in the Republic of Moldova (in schools, gymnasiums and lyceums)*, Chisinau, 2013, p. 4

[73] Decision No. 301 of 24.04.2014 on approval of the Environmental Strategy for 2014-2023 and the Action Plan for its implementation, State Register of Legal Acts of the Republic of Moldova, URL: http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352740

[74] Education Code of the Republic of Moldova, State Register of Legal Acts of the Republic of Moldova, URL: http://lex.justice.md/md/355156/

other optional disciplines at least with some bearing to the environment: “Renewable energy resources” (grades 7 to 9), “Chemistry and exploration of the environment”. According to the most recent Framework Plan (2017-2018) “each student, with the exception of students in the specialized / bilingual schools, must study at least one optional discipline”[75].

Currently, the primary and secondary education levels are awarded the following number of hours for disciplines: “Sciences” (grades 2 to 5) - one hour per week; “Biology” - 6th grade - one hour per week, grades 7 to 9 - two hours per week; “Chemistry” - 7th grade - one hour per week, 8th - 9th grades - two hours per week; “Geography” - grades 5-9 - one hour per week. Optional subjects in the field of “Mathematics and sciences”, where “Environmental education” and “Renewable energy resources” are included, are allocated 0-1 hours / week in grade 1 and in grades 2-9 the number of hours is 0-2 hours / week.

In high school (lyceum), the number of hours allocated to the disciplines listed above depends on the chosen profile (humanities / science). For example, in Biology the humanities profile has one hour per week (grades 10-12), while in the Science profile - two hours in the 10th grade and three in the 11th; for Chemistry, the humanities profile has one hour per week (grades 10-12), and in the sciences profile – three hours/week (in the 10th and 12th grades) and two in the 11th grade; for “Geography” in both the humanities and science profiles two hours per week are allocated in grades 10-11 and one hour in the 12th grade. With regard to the optional disciplines, in the humanities profile 0-1 hours / week are allotted, and in the sciences - 0-2 hours / week.

If we study more closely the contents of each curriculum as included in the disciplines, we can conclude that the subject of environmental protection and climate change is treated relatively sporadically and sometimes overlapping occurs instead of even distribution of the subject throughout the educational cycles. For example, in the secondary cycle, in “Biology”, “Ecology and environmental protection” a special module exists in the 12th grade with 28 hours for the Science profile and 9 hours for the Humanities one. However, “Geography” (lyceum cycle) comprises “Areas of environmental degradation” + “Environmental protection” (13 hours) and “The current problems of the natural environment and those of the modern world” (7 hours) also in the 12th grade.

III. Secondary Vocational Education

The system of vocational secondary education comprises 67 institutions - vocational schools (46) and trade schools (21), which aim at training qualified professionals in order to easily adapt to the labour market requirements in various economic sectors. These secondary vocational education institutions are open for both secondary school (gymnasium) graduates (the duration of the studies is 3 years for vocational schools, 1 year - for trade schools) and for secondary schools and high school (lyceum) graduates (the studies last a year in both cases). The institutions in question focus on creating a set of competences and boosting their development to a level that meets the demands and challenges of the economic environment.

At the same time training in secondary vocational education is carried out, at all levels, on the basis of educational programs, which include the components: general, technical-professional education and internship in production. The purpose of vocational education and training consists in the formation of a highly qualified person who will contribute to the creation of material values, enhancement of social welfare and the development of an active, independent, mature person able to cope with national needs”[76].

In these schools, elements of ecological education are taught largely through biology, geography and physics classes, with the possibility, under the Framework Plan for secondary technical vocational education, to choose environment related disciplines as optional, such as be “Man and the environment”. Where the student decides to pursue the field of forestry, agriculture, etc., ecology will also be part of the training package.

In the technical vocational education there are also Centres of Excellence (11), with the mission to “... develop, make more efficient and improve the quality and relevance of technical vocational education, oriented to the requirements of the national economy at local, regional, national and sectorial level, to ensure the synergy between the education system and the real sector of the economy[77]”. Thus, in Moldova there are the following excellence centres: Centre for Excellence in Energy and Electronics, the Centre for Excellence in Horticulture and Agricultural Technologies in Taul, the Centre for Excellence in Vineyards and Wine Making in Chisinau and others.

IV. Specialized Secondary Education

Of the 32 specialized secondary schools in the Republic of Moldova, the College of Ecology in Chisinau (duration of studies - 4 years) is responsible for training of specialists in “Ecology and environmental protection” (more precisely - in the ecological inspection and expert evaluation), “Forestry and Public Gardens”, “Tourism”, “Geodesy, Topography and Cartography”, “Fire Protection”. In each of these areas, 30 students got qualifications in 2017 (except for “Tourism” where 60 people got qualifications).

V. University Education

In the Republic of Moldova there are 18 state owned universities and 12 private ones. Among them, a few offer Bachelor and Master programs that focus on training professionals in environment in all its complexity, with its mechanisms, its problems, and ways to manage them. For example:

- “State University of Moldova [...] – specialization “Ecology” and “Environmental Protection”[...];
- Technical University of Moldova - specializations “Engineering and water protection”, “Environmental engineering”;
- Tiraspol State University - specialization “Biology” and “Ecology”;
- State Agrarian University of Moldova - specializations “Plant protection”, “Environmental engineering”, “Ecology”;

[75] National curriculum. Framework Plan for primary, gymnasium and lyceum education for school year 2017-2018, Ministry of Education of the Republic of Moldova, Chisinau, 2017, p. 6, URL : http://www.edu.gov.md/sites/default/files/plan_cadru_2017-2018_var._rom_rus_final_plasat_pe_site_me_12.05.2017_f.pdf

[76] Vocational education at secondary education level, Ministry of Education of the Republic of Moldova, URL: http://edu.gov.md/ro/content/invatamint-secundar-profesional

[77] Order No. 1158 of 04.12.2015 on approval of Framework Regulation on structure and operation of the Excellence Centre, State Register of Legal Acts of the Republic of Moldova, URL: http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=362790

- Free International University of Moldova - specialization "Ecology" etc.[78]"

In addition to specializations already mentioned, according to the Decision No. 482 of 28.06.2017 on approval of the Classificatory of Vocational Training Areas and Specializations in university education, we find other environmental study programs within the first cycle (licenta level) either as a central research discipline or as a constituent of the curriculum, such as: "Ecological chemistry and Chemistry of the environment", "Hydrology and meteorology", "Soil sciences", "Biotechnologies", "Engineering of renewable energy systems", "Geodesy and cadastre engineering", "Horticulture", "Vineyards and wine-making", "Animal husbandry", etc.

VI. Postgraduate (Postdoctoral) Education

This level is the most advanced in the structure of education (the tip of the educational system's pyramid) and it is addressed to those who already hold the PhD title and want to become a "habilitated doctor". Postgraduate studies aim at bringing the theoretical and practical knowledge to a completely different level of understanding and application, knowledge that is expected to be materialized in tangible results (scientific papers which bring about elucidations, explanations, innovations, solutions and research to ensure community progress and welfare).

"The decision to admit individuals to postdoctoral studies is taken by the academic senate/scientific council of the PhD institution based on the recommendation of the chair/department/laboratory/creative group where the thesis will be developed and the list of scientific publications in specialized journals will be submitted[79]."

9.2. Ecological Training

Upon review and examination of reports on implementation of the Environmental Strategy for the period 2014-2016, an intensification of actions dedicated to meeting the specific objective 3 of the Strategy was found, namely "Enhancing the level of environmental knowledge among pupils, students and employees by at least 50% by 2023 and ensuring access to environmental information"[80].

More specifically, measures were taken in the first stage to mainstream ecological education as an optional discipline in primary and general secondary education, as outlined in the description of the educational system, with a view to gradually mainstream it into the compulsory part of the curriculum.

In this respect, a sets of thematic didactic materials ("Teaching support" and "Guide for teachers") was developed in 2014, while in 2015 at the International Book Fair for Children and Youth (19th edition) „Arc", „Stiinta" and „Cartdidact" publishing houses launched, for each cycle of education, the didactic set "Ecological education", a project supported by the National Ecological Fund[81]. The latter, in 2016, also cared for the supply of teaching materials in the environmental area to public pre-school institutions.

The Ministry of Environment[82] organizes and supports initiatives dedicated to facilitating access to information and activities to create a practical framework for the implementation of environmental protection and, at the same time, to build awareness in the public.

These include:

- Cleaning campaigns (for example, "Hai, Moldova" was one of the 13 campaigns in 2016);
- Conferences (regional conferences on the need to create an integrated waste management system, an international scientific-practical conference entitled "Environment and Climate Change - From Vision to Action" carried out in 2015);
- Round tables;
- Programs and thematic articles ("Eco Monitor" at Vocea Basarabiei, "Nature in the lens" at Moldova 1, "Eco-Terra" at Radio Moldova, "Natura" magazine, "Environment" magazine);
- Continuously updated information on the website of the ministry (www.mediu.gov.md/http://www.madrm.gov.md);
- Interactive contests and national and raion level ecological Olympiads;
- Flash mobs;
- Consistent cooperation with environmental NGOs (the Moldovan Ecological Movement, REC Moldova, the National Environmental Centre, Bios, Eco-Terra, Gutta Club etc.) and the rest of civil society in actions such as:
    - "A tree for our survival" which aims to help increase the degree of afforestation of the country (for example, 226,230 trees and shrubs were planted in 2014);
    - The "Day of the Planet" (in 2014 for one hour, the Square of the Birth of the Lord Cathedral, the Stefan cel Mare si Sfant Park, the Great National Assembly Square, the Botanic Garden Street and the Botanical Gardens were not illuminated and, at the same time, many public institutions joined the campaign, while various activists participated in the 60+ flash mob and in 2016 as well as in 2015 the pedestrian zone on Eugen Doga street was disconnected from electricity networks, public institutions and banks joined the campaign and the "60+" flash mob and the contest "Smile - The Planet Loves You" was organized;
    - An information and awareness campaign "The Caravan of Biodiversity" was organized, through which delegates from the Ministry of Environment visited educational institutions of the Republic of Moldova, interacted with students on the importance of the biodiversity discipline and biodiversity protection by donating materials useful for study;
    - Velohora (Orhei) – a campaign promoting cycling;

[78] Report on implementation of the Environmental Strategy in year 2016, Ministry of Environment, p. 7-8, URL: http://www.mediu.gov.md/index.php/strategia#Rapoarte

[79] Admission to postdoctorate studies, National Council for Accreditation and Assessment, URL: http://www.cnaa.md/normative-acts/normative-acts-guvern/phd/x/

[80] Decision No. 301 of 24.04.2014 on approval of the Environmental Strategy for 2014-2023 and Action Plan for its implementation, State Register of Legal Acts of the Republic of Moldova, URL: http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352740

[81] Report on implementation of the Environmental Strategy in year 2015, Ministry of Environment, p.7, URL: http://www.mediu.gov.md/index.php/strategia#Rapoarte

[82] We will refer mainly to the activity of the Ministry of Environment from 2014 up to 2017 until the recent institutional reform which decreased the number of ministries, whereby the competences of the Ministry of Environment were transferred to the Ministry of Agriculture, Regional Development and Environment.

- Love your River (The Vatra Complex);
- Night of Bats Festival (Orheiul Vechi);
- Awareness building campaign on environmental issues - "The City I Want to See" (2016);
- Every year - "International Day of Zoos and Parks" (August 9), "World Wetlands Day" (February 2), "World Water Day" (March 22); "Earth Day" (April 22); "The Nistru River Day" (last Sunday of May), "International Day for Protection of the Ozone Layer" (September 16), "Danube Day" (June 29), etc.[83];

- Publishing of books through support by the National Ecological Fund: the third edition of the Red Book (2015), the "Population Structure of Spontaneous Oak Species" (2016), "Encyclopaedia of Ecological Vineyards" (2016), "Birds. Illustrated Encyclopaedia "(2016)," The Regal Forest (Padurea Domneasca) Reserve "(2016);
- Legal acts such as document No. 1467 of 30.12.2016 on approval of the Regulation on access of the public to environmental information;
- Development of the draft Concept of Integrated Environmental Information System, with the support of UNDP Moldova[84].

9.3. Public Information Campaigns

"Quality of education" and "quality of life" are closely related, and a strong information and awareness building system for the general public in the field of environmental protection (and not only) can make a significant contribution to the positive use of the interdependence between the two notions.

In the Republic of Moldova, there is a variety of sources and means to encourage the development of ecological awareness, such variety allowing the information to be accessible to most of the population. The awareness sources and means include the most conventional ones: the media (TV, radio, printed media), internet, school, books, films, environmental NGOs, local and national public authorities; but also some unconventional ones (which in the meantime have become very popular and widely used) - social media (online social networking campaigns - Facebook, Instagram, Twitter), flash mobs, excursions, thematic festivals, visits of experts to educational institutions in the urban space, but more specifically, in rural communities.

At the same time, it is worth emphasizing that the media, especially the specialized ones, had played a leading role in the formation of ecological culture reinforced by education, information, awareness building. The effectiveness of such campaigns and all of the above-mentioned actions would have been less and devoid of content if journalists, especially environmentalists, were not involved in promoting them prior to implementation of actions and afterwards (to report on effects produced or lack thereof). Moreover, in various situations, journalists, through their work, were able to notify the authorities about national environmental problems and to make authorities mobilize resources to solve them.

For example, from among the printed media, Natura magazine, which is a genuine school for "environmental education" for over 25 years, in addition to helping in enhancing the visibility of the less visited destinations, but worth seeing, in addition to educational contests and honorary invitations (interviews) with decision makers, artists, teachers, directors of institutions etc., provides also advice on healthy lifestyles, publishes fascinating stories and letters from readers, and it is also a tribune to support and manifest the civic spirit. Almost each issue of the magazine raises alarm through articles, open letters, and requests to competent bodies on a number of local, regional or national issues or irregularities, whether it be the destruction of a segment of the country's cultural, historical and natural heritage, or rivers suffocated by waste, illegal deforestation, unauthorized quarries, excessive pollution, etc.

In the same context, the TV programs (recorded in special spots of nature) of "Nature in the lens" channel (Moldova 1), build a bridge between the viewer and the environment in different parts of the country. They show "the activities of the society that lead to the protection or destruction[85] of the environment" and reveal "less known details about the natural reserves across the country, the value of the national heritage in protected areas and their importance in the ecological system of the Republic of Moldova[86]". Among the 2017 programs, two of the addressed themes were "Using renewable energies to mitigate environmental impact" and "Impacts of climate change on wildlife and wildlife species". "Eco Monitor" programs from "Vocea Basarabiei" were in the same category and they included thematic discussions with environmental experts.

The EcoFm is a radio station devoted exclusively to ecological topics (entitled "Between yes and no", "Chronicles of knowledge", "Birds - the colours of nature"), while, in terms of internet media, EcoPresa.md, a platform created by the Association of Environmental Journalists and Ecological Tourism of Moldova, with priority given to environmental news and analyses, and the aim "... eco-awareness and environmental awareness, promotion of personalities from environment and ecological tourism areas and on site events, analyses and interviews with officials and opinion leaders from the area of environment and ecological tourism"[87].

In addition, when talking of the environment, as it was stated at the beginning, only classical education is not enough in the process of public awareness. Thus, education is using non-formal or informal methods, that is, using creative, live methods, which can easily catch the attention, reach the soul of the people and get imprinted there. People tend to understand and remember more when they live what they learn, therefore any form of art (artistic expression) is deemed to be essential in raising public awareness.

For example, during the period August 1 to August 31, 2017, the Contest of Essays and Drawings "Act on CO_2", was organized by the Association of Women for Protection of the Environment and Sustainable Development (an NGO) in cooperation with Climate Change Office (Ministry of Agriculture, Regional Development and Environment).

[83] Report on implementation of the Environmental Strategy in year 2016, Ministry of Environment, p. 9, URL : http://www.mediu.gov.md/index.php/strategia#Rapoarte
[84] *Ibidem*

[85] Mature in a Lens, Teleradio Moldova, URL : http://www.trm.md/ro/natura-in-obiectiv/
[86] Ibidem
[87] About us, EcoPresa, URL : http://ecopresa.md/despre-noi-ecopresa-md/

Picture 9-1: Award giving ceremony for the national competition "Act on CO_2"

In October 2017, Natura magazine published an article, accompanied by pictures of winning drawings and a series of quotes from essays of participants (not just pupils, students and teachers), stating that the competition "... had the objective to encourage the involvement of citizens, especially young people and women, in climate change issues. It also sought to create consensus on the understanding of the phenomenon and the measures that can help to mitigate climate change from the level of an individual to the global level. Another objective was to remove barriers impeding the actions of young people, as well as to encourage them to make a real and lasting change in behaviour. By achieving these goals, a contribution will be made towards reducing CO_2 emissions and the achievement of the objectives of the Republic of Moldova under the UNFCCC[88]."

This is just one of the recent examples of cooperation between organizations, authorities, the media in carrying out on-going activities for information, training and awareness building in the area of environmental protection and climate change.

And since Climate Change Office we mentioned above, one of the sociological tools, a survey, should be noted which was used by the Office to assess the knowledge of the population in climate change. Thus, from May 29 to June 16, 2012, a survey was carried out entitled *"The Republic of Moldova: climate change knowledge of the people"* (the sample included 804 respondents). The survey has revealed the issues related to climate change which requires additional efforts to inform and raise awareness, the number of non-responses being quite high at the time.

From 13 October to 4 November 2017, a similar survey (sample – 1,134 respondents, aged 18-71+, maximum error - ± 3.0%) was carried out which allowed to analyse, to a certain extent, how had the perceptions and knowledge of a representative part of the Moldovan adult population evolved over five years.

By comparison, we notice, first of all, that for most of the questions the percentage of non-response or of participants who did not know the answer has considerably decreased.

Secondly, the responses seem to show a somewhat more advanced awareness of environmental issues and their causes, although there are still issues that got blurred or confused responses (e.g. Climate vs. Temperature Estimation).

Thirdly, taking into account the particular importance of an instrument as effective as the survey for the correction, completion and development of environmental policies, including those related to ecological education, climate change, access to information, public participation in decision-making, raising the awareness and ecological culture of the society, the belief is that surveys are a useful and necessary tool for continuing measuring of the collective perception, while the range of questions should be much more diversified and should encompass the field of environmental protection in all its complexity.

This is the only way to open up the possibility of intervening and transforming public opinion and society into a partner in problem solving, and into a friend of nature.

Below, the results are presented of the new survey along with conclusions drawn from interviews. At the same time, it is worth recalling that initiatives, such as the respective survey, are very welcome and can serve as a representative

[88] *Because we care*, Natura magazine, Universul publishing house, Chisinau, October 2017, p. 14.

measurement of public opinion whereby the questions shall be continuously adjusted to current realities.

9.3.1. Beliefs and Concerns Related to Climate Change

From a sample of 1,134 people, 996 (87.8%) believe the global warming does take place, as opposed to 85% in 2012 who had such beliefs; 10% do not believe (12% - in 2012) that climate change takes place at all and 2% do not know or do not want to respond (3% - in 2012). It is interesting to note that regardless of gender (male, female), age (15-25; 26-40; 41-55; 56-70; over 71), education (incomplete secondary education, general or vocational school, high school / university education), occupation (employed, temporarily unemployed, unemployed), nationality (Moldovan / Romanian, others), spoken language (Romanian or other) or residence medium (municipalities, other towns, villages), within almost all the categories over 80% believe that global warming does take place, which may serve as a potential indicator that the topic is of universal interest. However, when the a more precise response is sought ("How confident are you that global warming is really happening?"), it is found that 81% are rather sure or very confident, and 15% - extremely sure that climate change takes place.

About 40% of respondents perceive global warming as a consequence of anthropogenic activities and natural change, while 35% (as compared to 26% in 2012) identified human activities as the primary source of the phenomenon. Others (20%) believe that natural change is the real cause of global warming. For 45% of the people, this topic is if some concern, while 28% say they are very concerned and other 26% are less concerned or not concerned at all.

9.3.2. Perception of the „Greenhouse Effect"

Half of the respondents have heard about the cause-effect relationship between the "greenhouse effect" and "global warming", while 49% - have not. Unlike the situation in 2012, when 51% of the sample considered that "greenhouse effect" refers to "gases in the atmosphere characterized by their high infrared absorption capacity" currently 44% know what is behind the concept, while many (32%) associate the "greenhouse effect" with the "ozone layer that protects the Earth" or "pollution that causes acid rain" (16%). Regarding the factors that influence the average temperature on earth (greenhouse gases, volcanic eruptions, etc.), the figures show that most of the respondents tend to opt for relatively neutral answers ("to a certain extent", "slightly") than for firm answers ("not at all" or "very much") when faced with several options. At the same time, the percentage of those who do not want to respond or say they do not know the answer is significantly higher.

9.3.3. Weather Versus Climate

Upon analysis of data, we note that although 52.9% of the sample believe climate and weather to be largely interchangeable, in fact the percentage seems even higher, because 72.4% and 87.4% have provided the right answers ("Climate means average weather conditions in a region" and, respectively, "Weather changes from one year to another"), but at the same time 72.8% also agreed that "Weather means the average climate conditions in a region," and 83.7% - "Climate changes frequently from one year to another". We conclude that for a large part of the respondent population the distinction between the two notions is unclear.

9.3.4. Climate Change: in the Past and Currently

Almost ¾ of the respondents believe erroneously that the statement "Climate of the Earth currently is warmer than ever before" is probably true or certainly true, while 67.6% have the same opinion of the idea that "In the past, the climate of the earth was always changing gradually from warm to cold periods", which is also an erroneous idea. At the same time, 56.4% of the respondents correctly identified the correlation between the global increase of the atmospheric air temperature and the rise of CO_2 concentration, as well as the link between enhanced carbon dioxide concentration in the atmosphere and global increase of the atmospheric air temperature (58%). At the same time, such questions have also generated a high percentage of non-response among the population, (24.4% and 24.1%), however, the level of nonresponse was lower than in 2012.

9.3.5. Temperature Estimates

When asked to estimate the average temperature on Earth during the ice age as compared to the current one (14.5°C), 51.1% did not know the answer or did not want to answer. Some (28%) leaned towards the idea that temperatures were lower than 7.7°C and others (13.5%) that temperatures were higher than 10.6°C. Only 7.3% chose the right option - between 7.7 and 10.6°C. A similar situation was also noted when the respondents were asked to evaluate the average temperature on Earth 150 years ago - 47.9% did not respond, 33.9% rated the temperatures as lower than 7.7°C, 16.9% - as higher than 10.6°C, and 1.3% - between 7.7 and 10.6°C (the correct answer). With regard to the average temperature on Earth in 2050, if no further measures are taken to reduce and limit global warming and its effects, a significant percentage of the sample did not choose any of the options (36.9%) and 35.8% assumed that temperatures would be higher than 10.6°C, 18.2% - that they will be lower than 10.6°C, 18.2% - that they will be lower than 7.7°C, and 9.1% - that they will be between 7.7 and 10.6°C (the correct answer).

9.3.6. Fossil Fuels

As far as the population's knowledge of fossil fuels is concerned, there is an increase in knowledge as compared to 2012. Thus, most of the population correctly identified as fossil fuel - coal (84.3%, to be compared to 79.7% in 2012), oil (81.6% as opposed to 74.3% in 2012) and natural gas (79.6%, to be compared to 68.7% in 2012). On the other hand, there is also an increase in the incorrect identification of wood, hydrogen and solar energy as fossil fuels, between 7 and 15% of the population believing that these types of energy belong to the category of fossil fuels.

The categories of the public showing insufficient or inadequate knowledge about the subject are those with a low level of education who are (temporarily) unemployed, especially people from rural areas. Regarding the origin of fossil fuels, the knowledge of the population proves to be deficient, one third of the respondents not responding to the question. As of the year 2017, 37.1% of the population believed that the claim was true that fossil fuel energy originates "from the sun through plant photosynthesis for millions of years." The difference between 2012 and 2017 in terms of the percentage of people who correctly identified the origin of such fuels is only one point (25.2% vs. 24.3%).

9.3.7. Carbon Dioxide

When asked "Which gas is produced by burning fossil fuels?", 80% of the respondents correctly answered "carbon dioxide", an increase of 6 percentage points as compared to the level of 2012. However, 46% stated that it is probably true that ceasing burning of fossil fuels would have immediate effects, with the carbon dioxide concentration in the atmosphere again reaching pre-industrial levels, and 36% believe that if we stopped burning fossil fuels today, global warming would stop immediately. The population categories responding in this way are employed people with secondary education.

9.3.8. Causes of Global Warming

The answers given in this respect, where each of the mentioned cases has been given a relatively equal importance, show that the respondent population has no clear knowledge of the causes of global warming. Despite this, there were large differences between the percentages of 2012 and those of 2017. Thus, as regards to burning of fossil fuels for production of heat and electricity, 36.2% and, respectively, 48.9% of the respondents believed that this leads to global warming, to some extent or to a large extent as compared to 13.4% and 5.6% respectively in 2012. There were also large differences in the responses regarding the holes in the ozone layers (27.2/10.1%, 51.1/5.5%), aerosol sprays (32.2/20.3%, 29.5/8.1%), volcanic eruptions (34.0/16.8%, 43.8/ 6.3%) and acid rain (36.2/16.0%, 27.1/6.5%). The groups of the population with poor knowledge of the subject are those with a low level of education, mainly from rural areas.

9.3.9. Climate Change Beliefs

The percentage of those who believe that scientists cannot predict the climate over a long period of time remains high, 39.8% and 32.1% of respondents agree that this is probably or certainly true. Technology is still viewed with mistrust, 26.3% of respondents (compared to 17.1% in 2012) being sure that computer-generated climate models are not sufficiently reliable to predict the future climate.

More than a third of those interviewed believe that Earth's climate change has occurred naturally, people not being responsible for global warming and, moreover, that it is caused by the Sun. On the other hand, there is a decrease in the percentage of those who believe that global warming brings about more advantages than damage (15.3% compared to 20.4% in 2012). The percentage of those who gave no response to questions related to this issue was between 10.1 and 38.2%.

9.3.10. Elements of Impact

Although the phenomenon of global warming is still a topic which is not well known by those interviewed, 71.3% of respondents have correctly identified that global warming will in some places cause an increase of humidity and in others - desertification. Population groups that have considered this claim to be false or possibly false are those with a low level of education, not employed in the labour market, coming from rural areas.

Also, over two-thirds of respondents have correctly identified that global warming will result in higher yields in some regions and lower - in others. Most of these were young and middle-aged persons (age 15-40) with secondary or university education. It should be noted that people from rural areas took the lead in finding the correct response in this issue.

There is a decrease in the number of people who believe that global warming will cause the temperature to rise in similar way in all countries, 22.7% believing this to be false (compared to 13.7% in 2012) or possibly false (26.1% as opposed to 23.1% in 2012). Although there is a little improvement in the knowledge related to melting of glaciers, with 47% of respondents correctly responding that only a part of the glaciers are melting (compared to 46% in 2012), at the same time there is an increase in the percentage of those who believe that all glaciers on Earth are melting (14% vs. 11% in 2012). As many as 79% correctly state that the speed of glaciers melting has increased over the last hundred years.

Over 83% of respondents (41.4% probably or 43.7% certainly) have correctly associated ice melting in the frozen North Ocean and rise in ocean water temperatures (65.4%) with the rise of sea level. On the other hand, there is a slight increase in the percentage of those who incorrectly believe that this is due to the increase of the water evaporation phenomenon (38.8%/35.4% - probably, 26.6/23.5% - certainly).

When opting for a reason for rising of sea level, most respondents mentioned glacier melting (37% ice melting in the Antarctic, 32% - ice melting in the frozen North Ocean), while only 11% identified the correct cause, namely the increase of ocean water temperature (however, the percentage has improved as compared to the 2012 level, 8%).

A quarter (a 15% reduction as compared to 2012) could not say how much the sea level will rise by 2100 if no additional actions to reduce global warming are implemented, most of them opting for an increase in sea level of 90 -120cm. Last but not least, most respondents (42% vs. 33% in 2012) said they did not know anything about the increase in ocean water acidity and only 12% correctly identified the cause of the increase in ocean water acidity - the absorption of carbon dioxide by ocean water.

9.3.11. Solutions

Respondents were offered a list of actions and were asked to state to what extent they thought the respective actions could be solutions for reducing global warming. Based on responses a ranking was made of actions that could, to a certain extent or to a great extent, reduce the impact of global warming: Top ranking was given to the following actions: reducing quantities of toxic waste (86.6%), planting trees (86.1%), reducing destruction of tropical forests (85.8%), changing from petrol-fuelled cars to the ones based on electricity (81.8%), change from burning fossil fuels to use of renewable energy (73.5%), fewer personal car trips (72.9%), intensive use of public transportation (71.4%), while about 52% of the respondents said that the increase of taxes on fossil fuel could also be a method, although 32.1% had not fully agreed with it.

9.3.12. Information Sources

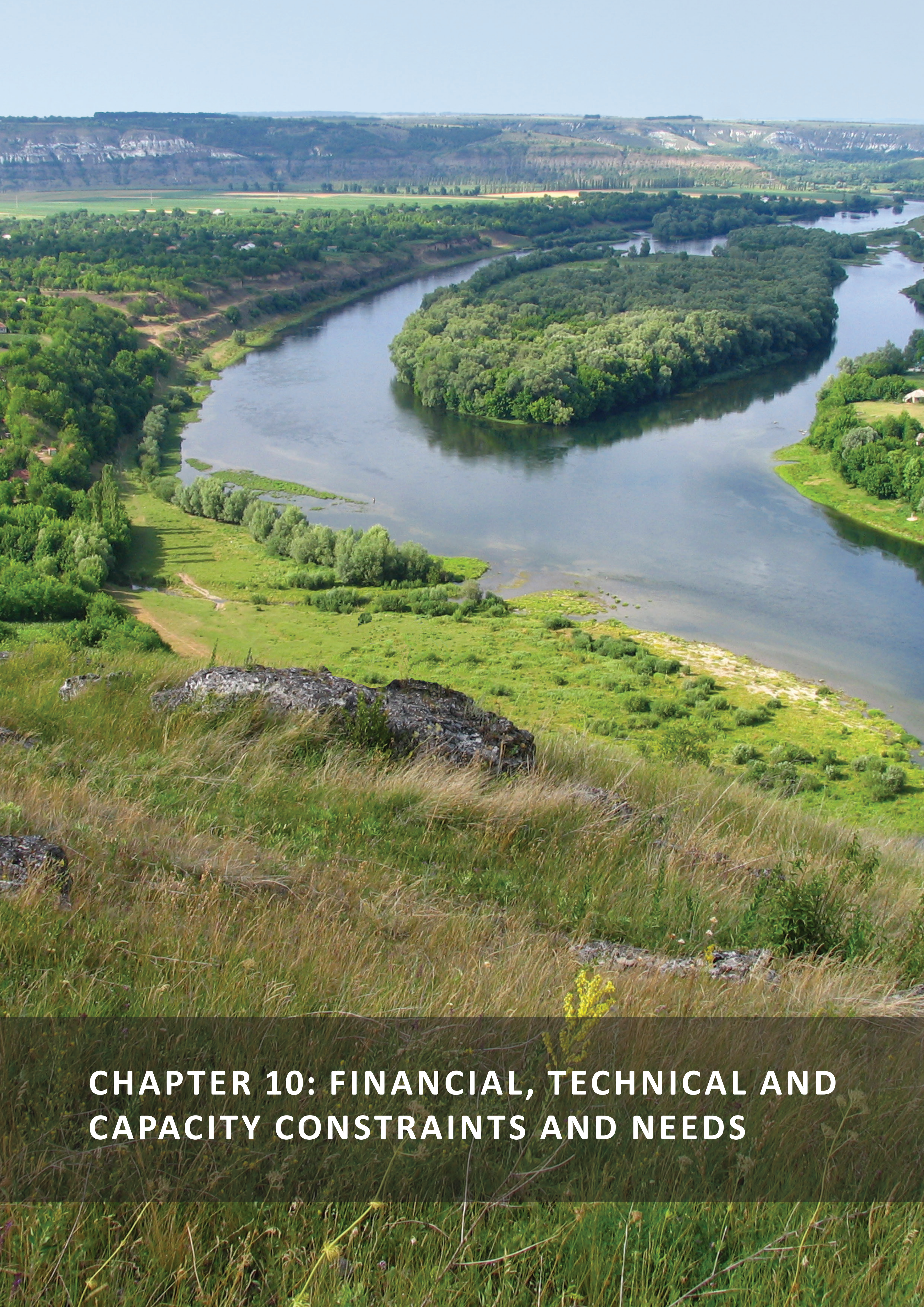
First of all, half of the 1,134 participants in the survey admitted that they would need more or even much more information on global warming, while 49% were generally satisfied with the level of information they had. Most of the respondents get global warming information from TV (67%), the internet (53%) and from movies (36.8%), and the least (or not at all) from museums, the zoo or the aquarium (83.7%) and the institutions which are subordinated to the Government (77.3%). Consequently, almost 80% turn to TV channels when they want to know about the topic, 72.7% - to the internet, 56% - to radio and 51% - to movies.

The representative of the people has the greatest trust in information provided by scientists (76.3%), documentaries on television channels, such as Discovery (67.4%) and environmental organizations (65.3%) (to some extent or very much). Less reliable sources as compared to 2012, in particular, became family members, acquaintances and friends (49.5%), while only five years ago, just 2.6% did not trust this source at all and 36.8% had a lot of confidence in this category, today the number of those who do not trust this group has reached 17%, having respectively, dropped to 9%, which may suggest preferences for a wider individual documentation.

In 2017, as compared to 2012, a steep decline was seen in visits (potentially educational) by respondents in 12 months to natural science museums - 81.6% have never visited a museum during one year (as compared to 3.4% in 2012), museums of science or technology - 85.3% (5.8% in 2012), zoos or aquariums - 67.5% (2.6% in 2012) and cinema halls - 73.3 (14.3 in 2012).

In the context of ecological education, it is worth noting that only 32.5% have learned much about global warming from school, 38% would choose the school to get this type of information, and respondents trust teachers in schools when they present things related to global warming to the extent of 53.2%. These figures do not seem very encouraging, but we have to take into account the variables in the calculations (age, level of education, etc.).

Thus, it is not surprising that certain categories of the public outside school age state that they have not learned too much information about global warming in school or that they would not choose school as a source of information about the topic. This is so for many reasons - either they have not been in contact with the academic sphere for a long time, or there has been little (or very little) emphasis on environmental issues and climate change when they were students. For example, respondents aged 56-70 (284 people) and the ones over 71 (74 people) said they learned little (or nothing) about global warming in school, the percent being 72.5% and 81.1%.



CHAPTER 10: FINANCIAL, TECHNICAL AND CAPACITY CONSTRAINTS AND NEEDS

CHAPTER 10: FINANCIAL, TECHNICAL AND CAPACITY CONSTRAINTS AND NEEDS

10.1. Constraints to Climate Change Mitigation

The financial, technological and institutional constraints on low carbon economic development in the key sectors of the national economy are described in the Environmental Strategy for 2014-2023 and in the Low Emissions Development Strategy of the Republic of Moldova until 2030 and Action Plan for its implementation. The most significant for each individual sector are mentioned below.

10.1.1. Energy Sector

The country lacks a proper regulatory framework, while the low payment capacity and relatively high cost of capital investments in the Republic of Moldova make the investments either too difficult to be made, or impossible to be returned.

Thus, the lack of adequate funding and technology transfer are among the barriers that restrict the efficiency increase of the thermal and power plants.

At the same time, most measures geared towards reducing GHG emissions require investment entailing increased prices for energy resources, which do not ensure the sustainable development of the economy.

The interest rates charged by the local banks for loans are generally very high, while foreign loans are exposed to significant risks, as the Republic of Moldova is defined as a country with a high-risk level (long-term risk is rated B3, the Risk Prime Rate (RPR) is 9.25%, according to *"Moody's rating"*[89]). For comparison, countries with the highest risk in the world for foreign investment are Greece, Ukraine and Mozambique, with the RPR of 14.21% in January 2017.

The investment risks of the Republic of Moldova are due to the Transnistrian separatist regime, in particular, as well as political and economic instability, which do not favor access to foreign loans.

Lack of interest for rehabilitation or construction of new power plants on a free electricity market is another important barrier. The availability of electricity generation sources (Ukraine and the Moldovan Thermal Power Plant - CTEM) at lower prices than the electricity production price from a newly built power plant, limits the investors' interest for construction of new power plants in the country.

It would seem, that an enabling legal framework for development of renewable sources is in place. At the same time, investors have reserves about it because the tariffs for electricity produced from RES are not known *apriori*, i.e. there are no *"feed-in"* type tariffs. As a result, it becomes problematic to achieve the objectives set forth in the strategic documents of the State regarding the promotion of renewable energy sources. After the entry into force of the new Law on Promotion of the Use of Energy from Renewable Sources[90], it is expected that it will booster the production of electricity from RES, because the ceiling price for this kind of energy will be known in advance.

The high investment costs of renewable electricity generation technologies and lack of security in terms of ensuring the balancing energy when these sources have to cover the effective energy demand throughout the day also represent a major barrier to expanding the renewable energy sources in the Republic of Moldova. An exception might be the use of biomass for heat production in rural areas, where a number of such projects have already been launched, with the support of development partners.

Once the objective of the Republic of Moldova accession to the EU is met, the country will have to compulsory comply with the EU emissions trading system (EU ETS). Consequently, activities aimed at CO_2 emissions reduction become an important factor for stimulation of energy efficiency in the Republic of Moldova.

Currently there is no clear international solution in terms of the policy framework regulating CO_2 emissions. At the same time, it can be surely asserted that mitigation policies will be based on market instruments and price capping.

This approach has been already confirmed by the European Union's decision to apply the CO_2 emission limits and prices within its territory. This means that the RM is due to begin preparation for institutional changes and to change the paradigm for all GHG issuing entities, including power plants, whereas once implemented, the system will cover not only emissions from international air traffic, but also the emissions from other emission sources.

10.1.2. Transport Sector

Reducing GHG emissions from the transport sector will require comprehensive changes in transport planning and infrastructure, as well as transition to low-carbon fuels. One of the barriers to improving the energy efficiency of vehicles is the perceived commercial risk of investment in energy efficient technologies development, which partially stems from the lack of clear regulatory signals, in the form of vehicle efficiency standards.

As far as demand is concerned, pre-operational costs for electric and hybrid vehicles are high. Lack of infrastructure for charging electric vehicles is also a barrier.

Fuels such as compressed natural gas, liquefied gas and biofuels (bioethanol, biodiesel) are being promoted as alternatives to less carbon-intensive fuels compared to conventional petroleum-based.

Domestic fossil fuel resources are very limited and the Republic of Moldova is faced with problems associated with security of supply, the problems being the same for the natural gas and petroleum supply.

[89] <http://pages.stern.nyu.edu/~adamodar/>.
[90] The Law on Promotion of Use of Energy from RES no. 10 of 26.02.2016, Official Gazette No. 69-77/117 of 25.03.2016.

The use of biofuel, taking into account the demand for arable land and water resources for irrigation, competes with more pressing objectives of internal policy related to ensuring food security.

A major challenge for the public transport infrastructure projects is associated with the very high pre-operational costs of capital.

Other issues include unsatisfactory urban planning and inadequate institutional mechanisms for managing the demand for transport in urban areas.

10.1.3. Buildings Sector

Many energy efficiency projects in the buildings sector are too small to attract the attention of investors and financial institutions. The small size of the project, together with disproportionately large transaction costs prevent energy efficiency investments.

In addition, the small share of energy spending in the disposable income of economically affluent groups of population, as well as the opportunity costs associated with often limited time of these groups to identify and implement effective solutions, severely limit the motivation to increase energy efficiency in the buildings sector.

Thermal insulation of apartments in multi-storey residential buildings encounters multiple types of difficulties:

- Tenants in buildings with district heating system have no interest in insulating the outer walls because heat consumed by his / her apartment is metered at the whole building level, i.e. for the entire building;
- Impossibility of tenants to regulate heat consumption[91]. In order to mitigate this problem S.A. "Termoelectrica" has launched a project under which approximately 125 dwelling blocks and 34 administrative buildings in the capital city will benefit free of charge of Individual Heat Points for heating and hot water preparation, located in the basement of the building[92]. Of the total number of blocks 17 residential buildings will be selected, where the horizontal heat distribution system will be installed. This upgrading will allow residents to have their own heat meter, to connect to or disconnect from the heat individually, to adjust the desired temperature in individual rooms and have hot water in a non-stop regime;
- Widespread poverty, unaffordable high prices for heat;
- Population migrating abroad[93];
- External walls insulation leads to decrease of the thermal load at the Chisinau and Balti CHPs and heat plants in other cities, resulting in decreased efficiency of these sources, electricity capacity released into the grid, and, as a result, freezing of investments made for construction of these facilities, and increase of heat price;
- The list of measures and of cost-optimal measures packages for the series type buildings in the Republic of Moldova is currently not available, it is still being developed according to the National Energy Efficiency Action Plan for 2016-2018[94] and the Roadmap for the implementation of the Law on Energy Performance of Buildings;
- Existence of damaged buildings, requiring major upgrades and significant financial means[95];
- Tenants usually resort to thermal insulation of external walls of their flats only when they have installed individual heating systems, a measure taken as a result of the low quality of the district heating services. In order to discourage installation of individual heating systems, the Government issued a decision by which the owners of the individual heating systems are required to additionally pay 10% of the thermal energy they would have received if they used district heating services[96].

10.1.4. Industrial Sector

Even though there is a wide range of cost-efficient technologies to reduce GHG emissions, full implementation thereof is hindered by a multitude of economic barriers.

The existing machines and equipment at industrial enterprises in the RM have a high degree of moral and physical wear and tear, and the State has limited capabilities to financially support restructuring and retooling of industrial enterprises.

On the other hand, loans from local and foreign banks for purchasing energy-efficient equipment are still very expensive and few businesses can afford the investment in modern equipment.

Another financial barrier is the high degree of instability of the national currency against the Euro and the US dollar, which puts loan reimbursement under high risk.

In industry there is a growing shortage of skilled engineering and technical personnel and a deep discrepancy between training of technical staff and the industry's needs.

The lack of enabling business environment is also a barrier to technology transfer. The ability of small and medium enterprises to access and absorb information on state of the art technologies is often limited. Even big companies have limited technical resources to interpret and translate the available information.

Still modest development of industrial parks and limited financial resources available for their development is an essential barrier in promoting innovations and know-how technologies in industry.

The more efficient use of energy resources is also hampered by:

- Inadequacy of policies promoting industrial energy efficiency and insufficient availability at national level of technical expertise, resources and programmes related to industrial potential resulting from energy efficiency improvements;
- Insufficient technical capacity of enterprises to identify, develop and implement industrial energy efficiency projects and further improve energy performance;

[91] Republic of Moldova: study on improving energy efficiency of buildings. J231 Citrus report: energy efficiency in the Republic of Moldova. 24 February 2015. <http://www.ednc.gov.md/upload/1/Studiu%20imbunatati-rea%20eficientei%20energetice%20cladiri%20de%20locuit%20din%20RM.pdf>.

[92] Several blocks in the capital will be equipped with Individual heating points. 21.02.2017. <http://www.moldpres.md/news/2017/02/21/17001408>.

[93] Emigration of population from the RM gets different: „We loose young, active, well trained population which will contribute to increasing European rather than Moldovan savings", 23.06.2016. <http://jurnal.md/ro/social/2016/6/23/emigrarea-populatiei-din-republica-moldova-capata-un-alt-caracter-pierdem-populatia-tana-ra-apta-de-munca-bine-pregatita-care-va-contribui-la-cresterea-economiilor-europene-si-nu-a-rm/>.

[94] Draft GD on approving the National Action Plan on Energy Efficiency for 2016-2018. <http://particip.gov.md/proiectview.php?l=ro&idd=3254>.

[95] Buildings maintenance fees could be raised in the capital of Moldova. 23.06.2016. <https://sputnik.md/society/20160623/7519816.html>.

[96] <http://lex.justice.md/document_rom.php?id=7D7A7EDD:A430988D>.

- Lack of funds for designing and preparation of industrial energy efficiency projects, development of good practices at the national level in order to support, build awareness and promote industrial energy efficiency;
- Obsolete standards (GOST), which do not allow to diversify products and contribute to maintaining a high level of emissions;
- Lack of energy service companies (ESCO) which would commit to helping small and medium businesses to find and finance efficiency improvements. Creation of energy service companies is constrained by the unwillingness to provide start-up capital by the financial institutions which are not used to the business model of these organizations. Recently a project funded by the Global Environment Fund (GEF), aimed at creating a functional and reliable market for companies providing services in the energy sector, was initiated.

10.1.5. Agriculture Sector

Agriculture Sector in the Republic of Moldova is a volatile and very risk prone activity, vulnerable to climate factors in particular (such as droughts, floods, frosts, hail falls, soil erosion). Reducing the dependence of such phenomena is a major challenge for the sector. Other barriers to the low emissions development are associated with:

- low budgetary allocations, especially for inventory base renovation, as well as lack of capital investments for assets renovation;
- insufficient financial coverage for the Agricultural Producers Subventions Fund (in recent years, agricultural subsidies did not exceed 3% of the budget spending)[97];
- underdeveloped agricultural insurance market;
- excessive fragmentation of agricultural land, which contributes to reduced yield of agricultural production due to non-use of soil cultivation technologies;
- underdeveloped conservative agriculture based on “no-till” and “mini-till” technologies with subsoiling works and maintaining a positive balance of humus, nitrogen and carbon in soil by systemic use of green and organic fertilizers;
- insufficient and non-proportional fertilization of agricultural crops with chemical fertilizers (20-25 kg/ha of active substance, of which 80-90% are chemical nitrogen fertilizers), gradual depletion of phosphorus and potash in soil with adverse effect on the yield and quality of agricultural production;
- incomplete use of organic fertilizers on arable land, which leads to lowering the effectiveness of fertilizers, creating a deeply negative balance of humus and carbon in soil, increased GHG emissions, deconstruction, strong compacting of the arable layer and increased risk of pedological drought with serious consequences for agricultural soils quality and production capacity;
- the lack of investments for animal husbandry sector recovery and for implementing sustainable manure management systems.

Unfortunately, alongside with some positive changes (privatization, multiple forms of production process organization, creating a competitive, initiative, entrepreneurship climate, etc.) these structural transformations have also caused an obvious disproportion between branches, resulting in the loss of jobs, reduced investments, high share of subsistence farms, using mostly outdated agricultural technologies; low labor productivity and high costs of production, excessive simplification of crop rotation, narrow product range, low quality of agricultural production, reduced use of mineral and organic fertilizers, i.e., a deeply negative humus balance and soil fertility, etc.

Forage crops and a part of industrial crops were eliminated from the crop rotations, including tobacco, sugar beet, but also vegetables, potatoes, oilseed crops, medicinal herbs and other crops with high added value. Production of the basic livestock products has significantly reduced due to the fact that the livestock sector is dominated by small scale production in individual households where extensive production technologies prevail. As a consequence, productivity of crops has reduced, while the environmental pollution increased due to the fact that manure is not applied on the fields as organic fertilizer, but remains stored within rural settlements areas.

In recent years, the share of foreign direct investment in agriculture accounted for only about 1.5% of the total investments, what indirectly confirms the reduced competitiveness of this sector of the national economy.

Speaking about animal husbandry sector, it should be mentioned that its development was particularly troublesome in the past 20 years, being hampered by competitiveness and market bottlenecks.

This branch is facing constraints related to internal resources (livestock numbers and productivity has decreased dramatically during the period of transition to a market economy; the production, processing and preserving forage has been virtually destroyed, being affected inclusively by adverse weather conditions, reduced availability of good quality pastures and insufficient irrigation), and with harsh pressure caused by cheaper imports of animals and animal products, imported mainly from the EU countries and the CIS, as a result of local relatively high production costs and low productivity, uncompetitive breeds.

All these, along with unstable animal husbandry sector support system operation, significantly retain production growth and create tough conditions for competing with imported subsidized cheaper meat / dairy products. As a result, in recent years the Republic of Moldova became a net importer of livestock products.

To improve the situation in animal husbandry sector urgent action is required, including:

- create new private property-based milk and meat production units to consolidate the livestock, increase product quality and level of standardization of production process;
- re-orientation of livestock business companies towards intensive animal breeding system by implementing advanced milk and meat production technologies, which will provide consumers with good quality and competitive products on internal and external market, and will contribute to the reduction of specific consumption of fodder and other material and financial resources;

[97] IFRA: report the results for the year 2016 subsidisation. <http://aipa.gov.md/ro/rapoarte>.

- increasing livestock production and producers' profitability by applying improved nutritional practices and technologies, use of modern animals breeding technologies, and by improving the genetic pool and feed;
- implementing modern manure processing technologies;
- improving the regulatory and business environment for investors willing to invest in the animal husbandry sector.

10.1.6. Forestry Sector

The biggest problems identified in the forestry sector relate to the improper forest fund administration, reduced bio-productive potential and poor guarding and protection of the forest fund. Activities carried out by the competent authorities are still insufficient to stop the considerable losses caused to forests by illegal cutting, estimated at about 400-600 thousand m^3 per year.

At the same time, the sector is facing serious problems related to inadequacy of the institutional and management framework for protected natural areas and lack of funding needed to ensure sustainable management thereof, undersized protected natural areas (only 5.5% of the territory) and areas covered with forests (only about 11.1% of the country's territory), and insufficient development and assurance of sustainable management of forests, green spaces, grasslands, wetlands, on-going degradation of rivers and water basins protection forest belts, which causes losses of habitats and ecosystems.

The RM does not have a National Forest Inventory and data collection process is not fully compliant with international requirements. Accurate and updated information about the amount, distribution, composition and overall condition of the forests (both public and private) is extremely important for the formulation of development and monitoring policy initiatives, provision of the necessary assistance and support to sustainable management, and compliance with national and international commitments.

Speaking about plant cultivation and soil resources, a long-term preservation of soil quality by increasing the content of organic matter in the soil (humus), is the only effective way of reducing GHG emissions from agricultural lands. Unfortunately, the strategies and sectoral programmes that have been approved so far did not have enough chances for success. As a result, over the past 20 years Moldovan agriculture has been based mainly on the exploitation of the natural soil fertility (the existing humus in soil was accumulated in soil for millennia). As a result, any increase of the yield caused by the climatic factor, if not followed by offsetting the loss of organic matter in soil, entailed increased GHG emissions. Thus, intensification of dehumidification processes as a result of subsistence farming has led to shrinking the reserves of carbon sequestration in the soil, increased CO_2 emissions and a decrease in quality and fertility of agricultural soils.

To improve the situation with the soils quality status, it is necessary to undertake the following urgent actions:

a) proper anti-erosion and hydrologic organization of farmlands, taking into account the pre-determined different land-use;
b) implementation of the soil conservation system by carrying out the required measures for preventive remediation of the properties of the black earth degraded arable layer;
c) developing a mandatory system of organic fertilization of soils by using green fertilizers; using organic waste from the basic agricultural crops; organizing the process of collecting manure and other organic waste for composting from individual households, and its subsequent implementation at community level (what will contribute to enriching the soil with phosphorous - a strategic element for crop productivity);
d) introducing crop rotation with participation of perennial and annual legumes, decreasing the share of hoeing crops;
e) harmless chemical fertilization (balanced, minimum required) of crops, primarily phosphorous fertilizers, etc.

10.1.7. Waste Sector

The legal framework related to waste sector of the RM was supplemented relatively recently with the Law on Waste no. 209 of 29.07.2016, and during 2017 the normative framework shall be developed, ensuring the enforcement of the Law.

As far as the institutional framework is concerned, it is still underdeveloped, requiring a restructuring of the respective legal framework and of the institutional structures for the implementation of investment projects aimed at creating an integral waste recycling and recovery system, as well as a biological - mechanical treatment or storage system.

Worsening of problems associated with waste management, including management of municipal solid waste, is explained by lack of the waste processing capacity.

Another important issue, encountered at the time of waste management infrastructure development projects, is lack of lands suitable to be used for solid waste deposit sites, what requires purchasing of these lands. In particular, it is extremely difficult to select the lands for regional SWSs and transfer stations, the topic becoming the subject of political debate to the detriment of environmental protection. Drafting of feasibility studies on development of integrated waste management systems is delayed because of failure to select the land.

Reduction of biodegradable fraction in the municipal waste require significant investments and specialized treatment facilities, distinguished by advanced technologies involving considerable operating costs. Although the Waste Management Strategy of the Republic of Moldova 2013-2027 provides for construction of municipal waste biological-mechanical treatment stations in Chisinau and Balti, these projects are currently not among the technological options considered in the context of feasibility studies in these regions.

It is worth noting, too, that the current waste management statistical system is based on a different approach than the one used by the EU.

10.2. Capacity Building Needs for Climate Change Mitigation

The GHG emissions mitigation capacity should be understood as ability of persons, groups that represent them, respective organizations and institutions to solve the problems attached to combating climate change, this activity being considered as an integral part of a series of efforts towards sustainable development[98].

Capacity needs towards mitigating GHG emissions are relevant and required to be available in four dimensions:

- to carry out the climate change studies, research and assessments;
- to formulate climate strategies and policies;
- to implement climate strategies and policies;
- to negotiate aspects of climate change at the international level, mainly in order to attract funds[99]

10.2.1. Capacity to Carry Out Climate Studies, Research and Assessments

As noted above in Chapter 6.1 of the TNC of the RM to the UNFCCC (2010), the RM has an extensive network of research institutions in different areas; however, there are no structures specifically dedicated to GHG emissions mitigation studies. This is justified by the fact that the country is not distinguished by sectors with significant GHG emissions, and the existing legal framework so far has not determined emission mitigation as a major priority of the country. At the same time the respective institutions continue to keep the climate change related research structures and quite skilled staff, what allows carrying out climate change related studies, including the preparation of National Communications and National Inventory Reports.

It is true, however, that not all of the same can be said about the available and applied calculation models, as well as about the information capacity about available. For example, starting with year 2000, the Institute of Power Engineering of the ASM (IPE ASM) received the right to use the ENPEP (Energy and Power Evaluation Program) package of models, the WASP and IMPACT models being used most frequently. Due to scarce funding, the specialists who successfully mastered those tools left the Institute, and as a consequence, the IPE ASM is now lacking the capacity to professionally conduct electricity sources development studies in the country. The same thing happened with the MARCAL calculation model. Use of other tools, such as MAED (Model for Analysis of Energy Demand), LEAP and other faces an impediment of a different nature. Input data for these are not available from credible sources, and independent experts should find significant time and financial resources to prepare the necessary information. In other words, the national system of statistics is far from being satisfactory for the purpose of conducting research on energy efficiency reserves and development of energy demand following the "bottom up" approach.

The assistance provided by the USAID and UNDP made it possible to identify the required changes in the statistical system of the country to allowed alignment to the EU statistical system. In other words, it is expected that in the not so far future the country will have official statistics which meet the requirements for conducting studies and research on GHG emissions mitigation.

[98] Donor assistance to capacity development in environment, OECD, Paris, 1995.
[99] Sagar, A. Capacity development for the environment: A view from the south, a view from the north, in: Annual Review of Energy and Environment 25, 2000, pages 377–439.

10.2.2. Capacity to Formulate Climate Strategies and Policies

On 14 December 2016 the Government approved the Low Emissions Development Strategy of the Republic of Moldova until 2030 (LEDS) and the Action Plan for its implementation.

The first draft of the LEDS was developed by international consultants with financial support on behalf of the Regional Office for Europe and the Commonwealth of Independent States (RBEC Bratislava) of the United Nations Development Programme (UNDP) and UNDP Moldova. Later, numerous local consultants were involved in the process, who have significantly contributed with changes to the document.

The Strategy was drawn up in accordance with the provisions of the Activity Programme of the Government of the Republic of Moldova "European Integration: Freedom, Democracy, Wellbeing" (2011-2014), the "Environmental Protection" chapter, and provisions of the "Climate Change" chapter from the Association Agreement with the European Union.

There is a wide range of other national and sector strategies already approved, related to the direct GHG emissions mitigation. Some of these have been developed mostly based on external donor support. In this regard, the energy strategies are relevant. The first Energy Strategy of the Republic of Moldova was approved by the end of 2000[100]. Basically, it has not met its objectives because of lack of proper attention to the energy sector. Aiming at making the Strategy more realistic, a new Energy Strategy of the Republic of Moldova until 2020 was developed and approved by the Government in 2007[101]. However, this Strategy has not been implemented in full because of the multitude of objectives which dispersed the attention of policy-makers and diverted it towards more important objectives of the country. In order to overcome the situation, a new Energy Strategy of the Republic of Moldova until 2030, largely developed by international consultants with the EU financial support, was approved in 2013[102]. The objectives set forth in this Strategy leave much room for reserves regarding actual accomplishment of the goals. Thus, in the next almost six years, about US$ 2 billion shall be capitalized, an incredible amount of investment for the Republic of Moldova which GDP in 2015 was only about US$ 6.5 billion[103].

Strategies developed for other sectors had similar destiny. The fundamental reason for such state of things, when the most important sector development documents produce no impact for the country, is lack of studies substantiating the objectives formulated in the policy documents. Otherwise speaking, the objectives set forth are rather some wishes, since they are not backed up by adequate justification of the social, technical-economic, etc. impact. Mostly, national consultants (i.e. national institutions) have the capacity to carry out such studies. The problem is the incapacity to formulate such studies and compile them as a credible strategic document. Donor assistance here is much welcomed. Such support should result

[100] Government decision No. 360 of 11 April 2000 "on approval of the energy strategy of Moldova until the year 2010." Official Gazette, 2000, no. 42-44.
[101] Government Decision no. 958 of 21.08.2007 on the Energy Strategy of the RM until 2020. Official Gazette No. 141-145/1012 of 07.09.2007.
[102] Energy Strategy of the RM until 2030. Government Decision no. 102 of 05.02.2013. Official Gazette No. 27-30/146 of 08.02.2013.
[103] <http://www.worldbank.org/en/country/moldova/overview>.

in a draft policy document that would pragmatically specify the need for such studies and financing arrangements.

10.2.3. Capacity to Implement Climate Strategies and Policies

LEDS contains sectors' GHG emissions mitigation policies and actions, most of which are also met in other policy documents. Many of these are aimed at meeting the objectives considered to be a priority for key sectors of the national economy, while the GHG emissions mitigation aspect has secondary importance in most of these policy documents. Merging sector policies with major impact on direct GHG emissions mitigation in a single document, i.e. LEDS, raises the likeliness of achieving the objectives, given the importance of the climate change issue at the global level, and availability of international support to cope with it.

Most of the activities proposed in the LEDS Action Plan are designed for a long term (2030) which, according to the Paris Agreement shall be revised every five years. Based on the actions in the Action Plan nationally appropriate mitigation actions will be developed, as a preliminary stage of actions implementation. The nationally appropriate mitigation actions will be designed by the Ministry of Agriculture, Regional Development and Environment in collaboration with line ministries. The responsibility for Strategy implementation shall lie within all competent institutions specified in the Action Plan.

Heading the country on the way to low carbon development requires the involvement of the strongest national institutions, an effective management and adequate assistance from the international community. In order to achieve the pursued objectives in GHG emissions reduction, donors financial support is also needed.

Institutional arrangements for Strategy implementation are expected to cover three main domains:

1) national planning and mainstreaming low emissions development priorities in the national regulatory framework and strategic development priorities;
2) efficient management of public finance and donor funding, of environmental-friendly technologies transferred to support the implementation of nationally appropriate mitigation actions included in the Action Plan;
3) monitoring and implementation control of the planned low emissions development actions from the Strategy.

Highlighting of low-emission development priorities in the national political agenda can be done by a national body, able to cover cross-cutting aspects of the response to all climate change challenges to support green economic development. Such a body is the National Commission for the implementation of the UNFCC provisions, as well as the mechanisms and provisions of the Kyoto Protocol, established by the Government Decision No. 1574 of 26 December 2003.

The technical tasks related to implementation of potential actions supported by donors and those likely to be credited in the energy, industry, transport and buildings sectors shall be imposed on the Energy Efficiency Agency (EEA) of the Ministry of Economy and Infrastructure; mitigation aspects - on the Ministry of Agriculture, Regional Development and Environment; mitigation aspects in Forestry - on "Moldsilva" Agency of the Ministry of Agriculture, Regional Development and Environment; and aspects related to Waste and Industrial sectors (refrigeration and air-conditioning) – on certain offices of the Ministry of Agriculture, Regional Development and Environment (Environmental Pollution Prevention Office, Ozone Office).

As mentioned above, the Republic of Moldova intends to meet the LEDS objectives by developing and implementing Nationally Appropriate Mitigation Actions (NAMA). Under the project "Low Emission Capacity-Building Programme", launched by the UNDP with the support of the European Union, the Governments of Australia and the Federal Republic of Germany in 2014-2016, the national experts, having the support of international consultants, were trained in development of such draft projects. From 136 project ideas four were selected for detailed development (to obtain financial support from donors), which largely look like business plans. The names of the actions are given below, while full text of the documents can be find at www.clima.md:

1. NAMA on promoting cogeneration plants in the Republic of Moldova
2. NAMA on promoting energy-efficient lighting in the Republic of Moldova
3. Afforestation of degraded lands, riverside areas and protection belts in the Republic of Moldova
4. NAMA on Waste to Energy (producing electricity from landfill gas) in the Republic of Moldova

It should be mentioned that implementation cover about 20% of the conditional INDC of the Republic of Moldova planned for year 2030.

In the context of preparing the Fourth National Communication under the UNFCCC (2017), development of the other eight NAMA is planned. The most suitable organizational arrangements for NAMA implementation is through the implementing units. The Republic of Moldova has extensive experience in using such mechanisms for implementing donor-funded projects.

Monitoring of the strategy implementation will be carried out by the Ministry of Agriculture, Regional Development and Environment.

To ensure the monitoring process, a monitoring group that will periodically assess progress in achieving indicators and objectives, will be designated by the order of the Minister of Agriculture, Regional Development and Environment. On the basis of collected and systematized information, the monitoring group will draft annual reports on Strategy implementation and will submit it to the Government.

10.2.4. Capacity to Negotiate Climate Issues at International Level

Typically, climate change is a complex horizontal set of issues, which are similar to other sustainable development issues. These issues require new capabilities such as the ability to establish long-term sustained commitments, create a strong political and integration coherence, and enter into partnerships between governments and civil society[104].

Climate change as a horizontal issue, require the availability of two kinds of capabilities: climate specific capabilities and climate relevant capacities. The climate specific capability implies the capacity to develop exclusively climate actions. At the same time, given that climate change is a cross-sectoral issue, the most significant institutional capacity, which might be necessary for the development of climate actions cannot be regarded as climate-specific, but rather climate relevant. This means that this capability shall be developed for purposes other than those directly related to climate change, and for concrete sectors, such as energy, transport, agriculture and forestry. And the display of such capabilities could have a very significant impact on the success of climate action or policies in this area[10575].

Starting from this division of capacities, Table 10-1 shows the specifics of the above mentioned capacities[75], as well as their availability in the Republic of Moldova now (in brackets, the score 10 is maximum availability, 1 - total lack).

[104] <http://pdf.wri.org/inst_capacity_climate_change.pdf>.

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Table 10-1: Climate specific and climate relevant capacities needs

Categories	Climate-specific capabilities	Climate-relevant capabilities
Staff	Sufficient availability of staff: at the Government level (7), experts (7), representatives of the business community and NGOs for assessments at national level (5), formulation of national strategies (7), design and implementation of policies and measures, as well as monitoring, reporting and verification (5). Reasonable level of climate specific powers and training skills (7) Presence of interest for climate change (6)	Availability at the governmental level and beyond of experts in policy development in climate relevant sectors: energy (8), transport (6), agriculture (7), forestry (8), industry (5), research and development (7), economy (7), finance (4), education (5). Availability of general training opportunities (7) Availability of financial and other types of incentives (4)
Organizations	Presence of: Specific mandate for climate change (8) „Unity" within the organization (7) Working climate for senior management (7)	Compatibility of organizations' objectives with the climate change related objectives (7), structured general management and processing abilities (7), availability of financial and human resources (5), large capacity to fulfill missions (4)
Network of organizations	Procedures and financial provisions (6), cooperation on climate issues (5), presence of a coordinating organizations (8), assigning of responsibilities (4) stability / adaptability of the institutional framework (6)	Practices and procedures in the public sector which underlie streamlining of policies (4)
Public governance	The ability to influence the policies of mass toward taking into account the aspects of climate change (7)	Political stability (3), the right to expose and responsibility (5); the ability to implement solid climate relevant policies and ensure a robust business environment (4), an independent public service (5), the ability to collect sufficient resources (5); rule of law and corruption control (3)
Social norms, values and practices	Knowledge about climate change and positive attitude towards climate change mitigation measures (8)	Compliance with laws (7); positive attitude towards the environment protection (7), cooperative attitude among citizens (7)

The level of availability of capacities listed in Table 10-1 predetermines the capacity to negotiate climate change issues internationally. Considering that negotiation in itself is an art and a science, maximum performance in negotiations cannot be achieved without knowledge transfer, as well as relevant best practices. In this regard, the Republic of Moldova needs relevant training, which is provided by donors based on pre-determined programmes, and systematically.

10.3. Financial Needs in the Context of Low-Carbon Development

Two types of funding are needed to achieve the GHG emissions reduction objectives in the context of low emissions development. The first relates to the need to achieve an adequate level of capacity in GHG emissions mitigation. The second should be the amount of investment needed to fulfill the measures and technologies contributing to the country's commitments on GHG emissions reductions.

Estimates have shown that for empowering the country to solve the low-emission development problems in the next five years about US$1.2 million would be needed, of which approximately US$ 0.3 million annually, and the rest as a onetime assistance, mainly from international donors. Part of the necessary resources of US$ 642 thousand was capitalized during 2013-2016 under the Global Project "Low-Emission Capacity Building Programme". More detailed information on the structure of above mentioned financial needs are listed in Table 10-2.

Table 10-2: Financing Needs to Strengthen GHG emissions mitigation Capacities in the Republic of Moldova in 2018-2021, US$ million

No.	Capacity building area	Financial needs	Comments
1.	Conducting studies, research and assessments in the field of climate change	0.30	To conduct surveys, research and assessments in climate change on an annual basis
2.	Formulation of climate strategies and policies	0.15	To formulate substantiation studies of the key elements of the strategies and sector action plans
3.	Implementation of climate policy and strategies	0.65	For developing NAMA in line with LEDS priorities
4.	Negotiation of climate aspects internationally	0.10	To have the opportunity to participate to wider extent in negotiation of future international climate agreements
	TOTAL	**1.20**	

The investments needed to carry out measures and technologies entailing reduction of GHG emissions identified by the RM and which, at the same time will ensure the sustainability of the national economy development, were determined based on the investments planned to be harnessed for the nationally appropriate mitigation measures identified in the LEDS. Table 10-3 below shows the amounts and timelines of funding needed to meet the Strategy objectives.

Table 10-3: Investments needed to fulfill the Intended Nationally Determined Contribution of the Republic of Moldova by year 2030, US$ billion[106].

The objective	Total for 2016-2030		2016-2020	Total for 2021-2030	
	with electricity import	without electricity import		with electricity import	without electricity import
Unconditional	3.741	4.627	1.328	2.413	3.299
Conditional	4.901	5.106	2.651	2.250	2.455
TOTAL	8.642	9.733	3.979	4.663	5.754

Meeting the unconditional objective of the strategy implies a bigger financial effort higher than the one planned under the baseline scenario. The latter provides for keeping the existing trend of GHG emissions. So, the financial resources needed to achieve the unconditional objective of the LEDS do not include funding of activities under the baseline scenario.

At the same time, the financial resources needed to achieve the conditional objective of the strategy depend on the unconditional scenario and donors and international financial bodies support.

Considering that the country's rate of dependence on electricity imports is 86.2%, and electricity production on the territory of the country significantly influences the amount of GHG emissions, the amount of funds needed to achieve the strategy targets depends on the amount of imported electricity. Therefore, in order to meet the unconditional objective of the strategy, by contributing own financial means only, about US$ 3.741 billion would be needed between 2016 and 2030 - if electricity import persists, and US$ 4.627 billion - without electricity import.

For the first period of strategy implementation (until the year 2020) the Republic of Moldova will not assume financial obligations to achieve unconditional actions. Until the year 2020 the country will contribute to achieving unconditional actions from the Action Plan, within the limits of budget appropriations for each institution involved in achieving the LEDS, according to spending strategies.

10.4. National Arrangements for LEDS and NAMA Implementation

Achieving the goals of the Republic of Moldova to reduce GHG emissions, set out in the INDC, is provided through NAMA, which are identified and fixed in the LEDS. In the latter document it is provided also an action plan towards implementation.

Most of the activities proposed in the action plan are for a longer term (2030) which, according to the Paris Agreement will be reviewed every five years. On the basis of measures in the action plan it will be developed appropriate mitigation actions at national level, which is a preliminary stage of implementation actions. Appropriate mitigation actions at national level will be elaborated by the Ministry of Agriculture, Regional Development and Environment in collaboration with line ministries.

The objective of the institutional arrangements for the implementation of the Strategy is to cover three main areas:

1) national planning and development priorities of integration with low emissions under national regulations and in strategic development priorities;
2) the efficient management of public funds and those offered by donors, environmental-friendly technologies transferred to support appropriate mitigation strategy implementation at the national level included in the action plan;
3) monitoring and controlling the implementation of the low-emission economic development actions planned in the Strategy.

Monitoring the implementation of the Strategy will be carried out by the Ministry of Agriculture, Regional Development and Environment. To ensure the monitoring process it will be created, by order of the Minister of the Agriculture, Regional Development and Environment, a monitoring group that will evaluate periodically the degree of achievement of the indicators and objectives. On the basis of information collected and systematized, it will draw up the annual report on implementation of the Strategy and will submit to the Government.

National GHG emissions, as well as their evolution trends are regularly reported in the National Communications of the Republic of Moldova under the UNFCCC and in the National Inventory Reports. These documents shall be drawn up on the basis of studies, research reports undertaken by national consultants, including with international experience in the specialty field, selected for calculation and assessment of the retrospective information, as well as development of short, medium and long-term GHG emission evolution scenarios for each individual sector, on the basis of macroeconomic development scenarios of the Republic of Moldova.

Additionally, aiming at improving transparency, consistency, comparability, completeness and accuracy of national inventory of anthropogenic GHG emissions from sources or removals of carbon dioxide in the sinks not covered by the Montreal Protocol, the Republic of Moldova has developed (by the end of 2015) the National Inventory System Report of the Republic of Moldova, using as the starting point six templates developed by US EPA.

As part of its continuous effort to develop a qualitative, reliable and transparent inventory, in 2005 the Republic of Moldova has developed a Quality Assurance and Quality Control Plan which is regularly updated. The characteristic features of the plan include specific detailed procedures and Tier 1 (general procedures) and Tier 2 (specific procedures for individual source and sink categories) templates for verification and quality control to standardize the implementation of the

[106] Source: LEDS

national inventory quality assurance and quality control procedures; also external technical review carried out by the staff not directly involved in drafting and development of the national inventory (both by national consultants, as well as by the international consultants included in the list of experts accredited by the UNFCCC); verification of the quality of activity data, including by comparing sets of data from different sources, planning and coordination of the inventory process at inter-institutional level, as well as documenting the ongoing national inventory development process.

The monitoring process will also include development of annual monitoring reports which shall contain information on implementation of indicators established for individual action, and assessment and progress reports assessing the impact of the activities carried out in during the period under review and the level of objectives implementation shall be developed every 5 years. The assessment and progress reports will serve as basis for revision of the Strategy Implementation Action Plan. The monitoring and evaluation reports will be submitted to the Government for review.

Towards the end of the strategy implementation a final evaluation report shall be prepared, containing information on achievement of objectives and expected impact. The basic evaluation report shall be presented to the Government, and shall serve as basis for deciding on the next steps for low emission development strategic planning.

The National Inventory Reports, Biennial Update Reports and National Communications of the Republic of Moldova under the UNFCCC shall be drafted by the Ministry of Agriculture, Regional Development and Environment through the Climate Change Office. The national inventory team within the Climate Change Office is responsible for calculating emissions and removals by sources and sinks, key emission sources analysis, inventory verification and quality control activities, uncertainty analysis, documenting and archiving the information about preparation of the national GHG emissions inventory.

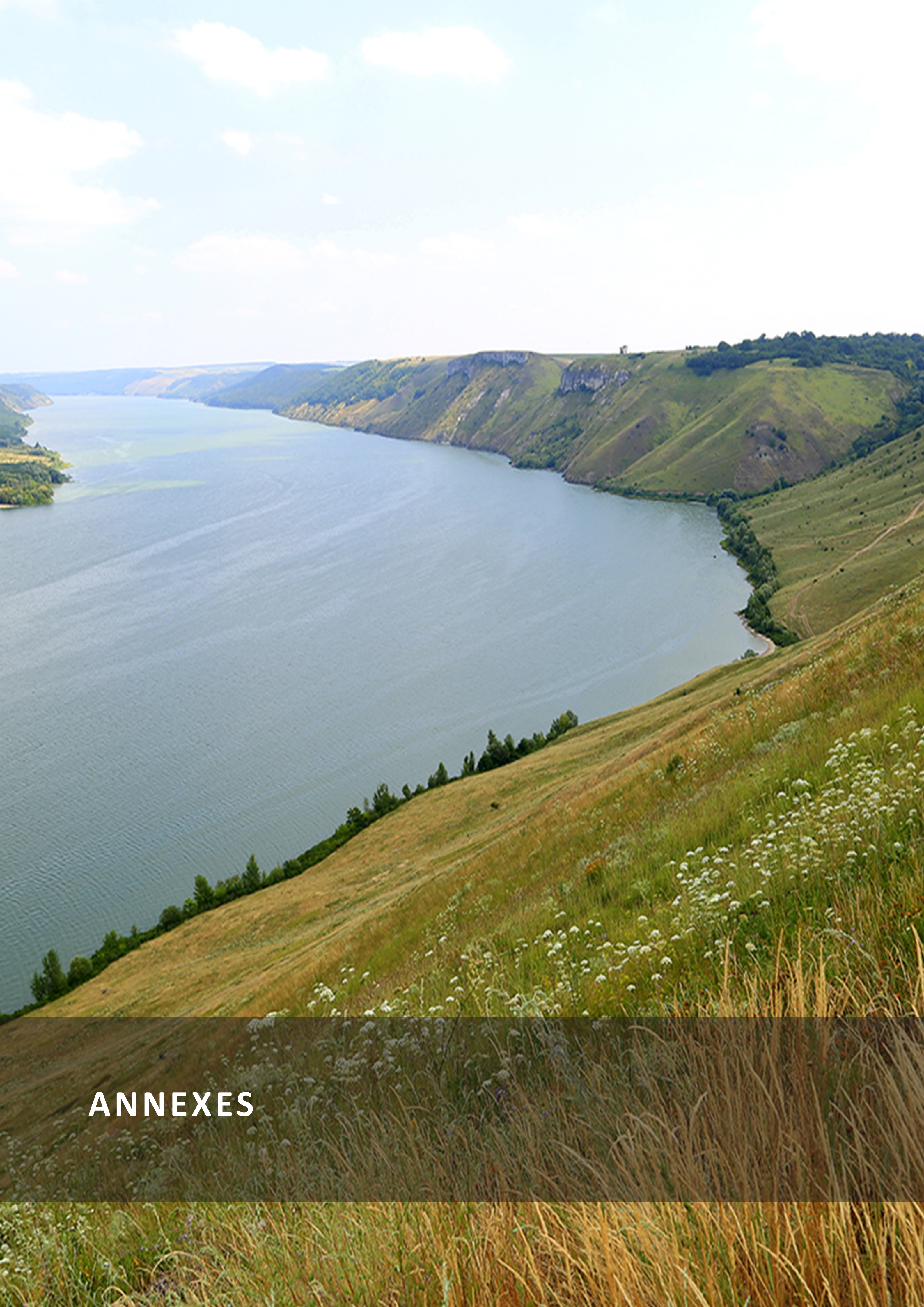
Aiming at reducing the costs and the time spent by the staff involved in monitoring, reporting and verification, the nationally appropriate mitigation actions will be monitored by means of a standard template, the draft of which has already been developed[107]. In this sense, the regulatory framework shall provide for the requirement to regularly supplement the template with basic information on ongoing or proposed nationally appropriate mitigation actions. Initially, the information shall be presented to the Ministry of Agriculture, Regional Development and Environment for processing through the Climate Change Office. However, once the Environment Protection Agency is in place, the technical function of the unilateral NAMA monitoring, reporting and verification body will belong to this entity. The template shall be used to monitor all types of mitigation activities aimed at emission reductions. The template for unconditional and conditional actions will also contain the request to submit information on the relevant NAMA implementation support (financial flows and their impact; technology transfer and its impact; capacity building and related impact etc.).

[107] Low Emission Capacity Building Project in the Republic of Moldova (2014-2016).

Monitoring, reporting and verification for the CDM projects shall comply with the UNFCCC requirements.

With reference to the process of approving the NAMA type activities, regardless whether it has the donors support or it is of the CDM type, it will be submitted to the National Commission in two stages. First, a concept note on the appropriate mitigation actions at national level will be presented, then at the second stage - the project document of the nationally appropriate mitigation action itself. Both documents shall contain a chapter on Clean Development Mechanism for the GHG emissions mitigation measures. After having evaluated the Concept Note on the nationally appropriate mitigation actions or the relevant Project Document, the National Commission shall issue a decision on the approval or rejection of the Concept Note or Project Document for the nationally appropriate mitigation actions.

The entire regulatory framework on development, approval, implementation, monitoring, reporting and verification of the nationally appropriate mitigation and adaptation activities shall be drafted by the Ministry of Agriculture, Regional Development and Environment in line with the UNFCCC requirements, in its capacity of a public authority responsible for promoting and implementation of these activities, and as the authority presiding the National Commission for the implementation and accomplishment of the UNFCCC provisions. The Ministry of Agriculture, Regional Development and Environment shall submit this regulatory legislation framework to the Government for approval. The regulatory framework shall also contain the amendments and updates to the Regulation of the National Commission for the UNFCCC provisions implementation, which is designated as the national authority responsible for the implementation of the UNFCCC provisions and the Kyoto Protocol provisions and mechanisms.



ANNEXES

ANNEXES.

Annex 1: Summary Reports on GHG Emissions in the Republic of Moldova within 1990-2015

1990

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**29012.7530**	**228.2508**	**9.6019**	**NO**	**NO**	**NO**	**NO**	**NO**	**137.2894**	**442.5964**	**183.0223**	**294.2491**
1. Energy	**33296.4997**	**45.9141**	**0.6256**						**133.3639**	**430.6217**	**73.2953**	**292.9100**
A. Fuel Combustion Reference Approach	33084.0361											
Sectoral Approach	33295.8620	13.4244	0.6256						133.3639	430.6217	72.7136	292.9100
1. Energy Industries	19338.0195	0.4429	0.1653						54.3056	4.9308	1.3291	203.2479
2. Manufacturing Industries and Construction	2206.2753	0.0982	0.0171						5.9159	1.4020	0.2003	24.1751
3. Transport	4346.0289	1.3053	0.3460						43.3474	299.7054	56.4524	5.1060
4. Other Sectors	7291.5661	11.5672	0.0928						28.9129	122.3226	14.3034	59.7859
5. Other	113.9722	0.0109	0.0044						0.8821	2.2609	0.4285	0.5951
B. Fugitive Emissions from Fuels	0.6377	32.4897	0.0000						0.0000	0.0000	0.5817	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.6377	32.4897	0.0000						0.0000	0.0000	0.5817	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**1580.9940**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.6575**	**5.4300**	**106.6288**	**1.3330**
A. Mineral Industry	1316.1041								3.5018	3.3740	0.0339	1.2687
B. Chemical Industry	NO	NO	NO						NO	NO	0.0650	NO
C. Metal Industry	28.5023	NO	NO	NO	NO	NO	NO	NO	0.0925	1.2102	0.0370	0.0427
D. Non-energy Products From Fuels and Solvent Use	233.2089	NO	NO						0.0434	0.2441	92.7937	0.0216
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO				
G. Other Product Manufacture and Use	3.1787	NO	0.0001	NO	NO	NO	NO	NO	0.0197	0.6017	1.4449	NO
H. Other									NO	NO	12.2544	NO
3. Agriculture	**0.5820**	**107.4205**	**8.4713**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		87.6278										
B. Manure Management		19.7927	3.7470								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			4.7243									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.5820											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						**NO**	**NO**	**NO**	
4. LULUCF	**-5882.4287**	**0.1068**	**0.2017**						**0.0963**	**3.5377**	**NE**	
A. Forest Land	-2543.7403	0.0089	0.0005						0.0057	0.2037	NE	
B. Cropland	-578.1271	0.0978	0.1907						0.0906	3.3340	NE	
C. Grassland	-2850.2941	NE	NE						NE	NE	NE	
D. Wetlands	-17.4403	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			kt CO_2 equivalent					(kt)			
E. Settlements	84.7480	NE	0.0105						NE	NE	NE	
F. Other Land	152.4756	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-130.0504											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1060**	**74.8094**	**0.3032**						**0.1717**	**3.0071**	**3.0982**	**0.0060**
A. Solid Waste Disposal	NA, NO	41.8691							NA, NO	NA, NO	2.9908	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	17.1060	0.3513	0.0081						0.1717	3.0071	0.0664	0.0060
D. Wastewater Treatment and Discharge		32.5890	0.2951						NA, IE	NA, IE	0.0410	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	217.3668	0.0430	0.0070						0.7949	0.8733	0.5202	0.0689
Aviation	217.3668	0.0430	0.0070						0.7949	0.8733	0.5202	0.0689
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	229.3072											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.9575**									
Indirect CO_2	**207.3247**											

1991

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**23396.6278**	**211.5870**	**9.1414**	**NO**	**NO**	**NO**	**NO**	**NO**	**124.4290**	**374.6690**	**155.2900**	**244.2434**
1. Energy	**29615.6682**	**39.7815**	**0.5709**						**120.7994**	**363.5195**	**64.3990**	**242.9820**
A. Fuel Combustion — Reference Approach	29387.3159											
Sectoral Approach	29615.0542	9.2890	0.5709						120.7994	363.5195	63.8552	242.9820
1. Energy Industries	17363.5768	0.3826	0.1457						48.8473	4.4530	1.2021	172.1415
2. Manufacturing Industries and Construction	1751.5621	0.0771	0.0133						4.6859	0.7688	0.1609	19.2292
3. Transport	4435.3173	1.1863	0.3444						44.7084	282.8296	53.3770	5.6146
4. Other Sectors	5984.1624	7.6360	0.0643						21.9131	73.9506	8.8220	45.4314
5. Other	80.4355	0.0070	0.0031						0.6447	1.5175	0.2932	0.5653
B. Fugitive Emissions from Fuels	0.6140	30.4926	0.0000						0.0000	0.0000	0.5438	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.6140	30.4926	0.0000						0.0000	0.0000	0.5438	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**1402.6293**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.3691**	**4.8820**	**87.9714**	**1.2554**
A. Mineral Industry	1182.6733								3.2328	3.0205	0.0315	1.2004
B. Chemical Industry	NO	NO	NO						NO	NO	0.0544	NO
C. Metal Industry	24.7297	NO	NO	NO	NO	NO	NO	NO	0.0803	1.0502	0.0323	0.0371

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	192.3631	NO	NO						0.0361	0.2030	76.2635	0.0180
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO				
G. Other Product Manufacture and Use	2.8632	NO	0.0001	NO	NO	NO	NO	NO	0.0199	0.6083	1.3014	NO
H. Other									NO	NO	10.2883	NO
3. Agriculture	**0.5226**	**97.8215**	**8.0901**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		81.2260										
B. Manure Management		16.5955	3.4991									
C. Rice Cultivation		NO										
D. Agricultural Soils			4.5909									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.5226											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-7639.3179**	**0.0961**	**0.1999**						**0.0886**	**3.2577**	**NE**	
A. Forest Land	-2323.6314	0.0015	0.0001						0.0010	0.0341	NE	
B. Cropland	-2097.4265	0.0946	0.1892						0.0876	3.2236	NE	
C. Grassland	-3317.4207	NE	NE						NE	NE	NE	
D. Wetlands	-17.4403	NE	NE						NE	NE	NE	
E. Settlements	88.7139	NE	0.0106						NE	NE	NE	
F. Other Land	152.4756	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-124.5885											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1256**	**73.8878**	**0.2805**						**0.1719**	**3.0098**	**2.9196**	**0.0060**
A. Solid Waste Disposal	NA, NO	43.9447							NA, NO	NA, NO	2.8159	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	17.1256	0.3516	0.0081						0.1719	3.0098	0.0664	0.0060
D. Wastewater Treatment and Discharge		29.5915	0.2724						NA, IE	NA, IE	0.0373	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	232.8115	0.0487	0.0074						0.8447	0.9641	0.5792	0.0738
Aviation	232.8115	0.0487	0.0074						0.8447	0.9641	0.5792	0.0738
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	427.7268											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.8158**									
Indirect CO_2	**170.6429**											

1992

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**14211.5365**	**194.3828**	**7.5922**	**NO**	**NO**	**NO**	**NO**	**NO**	**78.3613**	**176.3384**	**105.8855**	**169.7527**
1. Energy	**20487.2378**	**31.2304**	**0.3421**						**76.3110**	**166.9663**	**30.7516**	**169.0953**
A. Fuel Combustion Reference Approach	20392.5412											
Sectoral Approach	20486.7203	3.6261	0.3421						76.3110	166.9663	30.2584	169.0953
1. Energy Industries	13010.9387	0.2828	0.1102						36.6784	3.3396	0.8992	128.3280
2. Manufacturing Industries and Construction	1013.7705	0.0412	0.0071						2.6879	0.4219	0.0896	10.9365
3. Transport	2142.4037	0.5682	0.1929						21.9215	134.4383	25.3717	2.7015
4. Other Sectors	4257.3797	2.7295	0.0299						14.5814	27.9162	3.7324	26.5401
5. Other	62.2278	0.0044	0.0020						0.4417	0.8504	0.1655	0.5892
B. Fugitive Emissions from Fuels	0.5175	27.6043	0.0000						0.0000	0.0000	0.4931	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.5175	27.6043	0.0000						0.0000	0.0000	0.4931	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**814.3567**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.7974**	**3.3821**	**72.3206**	**0.6514**
A. Mineral Industry	634.3365								1.6705	1.6235	0.0165	0.6003
B. Chemical Industry	NO	NO	NO						NO	NO	0.0238	NO
C. Metal Industry	23.9922	NO	NO	NO	NO	NO	NO	NO	0.0780	1.0194	0.0314	0.0360
D. Non-energy Products From Fuels and Solvent Use	153.7706	NO	NO						0.0304	0.1706	62.9651	0.0151
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO				
G. Other Product Manufacture and Use	2.2573	NO	0.0001	NO	NO	NO	NO	NO	0.0186	0.5686	1.0260	NO
H. Other									NO	NO	8.2577	NO
3. Agriculture	**0.3905**	**94.7006**	**6.8113**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		79.7785										
B. Manure Management		14.9221	3.1392								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.6721									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.3905											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-7107.5776**	**0.0880**	**0.1810**						**0.0810**	**2.9804**	**NE**	
A. Forest Land	-2164.6662	0.0016	0.0001						0.0010	0.0373	NE	
B. Cropland	-2231.6719	0.0864	0.1660						0.0800	2.9431	NE	
C. Grassland	-3383.3454	NE	NE						NE	NE	NE	
D. Wetlands	-17.4403	NE	NE						NE	NE	NE	
E. Settlements	386.6196	NE	0.0149						NE	NE	NE	
F. Other Land	418.8904	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
G. Harvested Wood Products	-115.9639											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1291**	**68.3638**	**0.2577**						**0.1719**	**3.0096**	**2.8134**	**0.0060**
A. Solid Waste Disposal	NA, NE	45.6782							NA, NO	NA, NO	2.7135	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	17.1291	0.3517	0.0081						0.1719	3.0096	0.0664	0.0060
D. Wastewater Treatment and Discharge		22.3339	0.2496						NA, IE	NA, IE	0.0335	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	96.2635	0.0189	0.0031						0.3512	0.3847	0.2288	0.0305
Aviation	96.2635	0.0189	0.0031						0.3512	0.3847	0.2288	0.0305
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	531.1505											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.5170**									
Indirect CO_2	**140.7804**											

1993

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
Total national emissions and sinks	**8898.1834**	**183.8956**	**7.7396**	**NO**	**NO**	**NO**	**NO**	**NO**	**62.6903**	**150.0408**	**87.4951**	**137.1709**
1. Energy	**15345.5359**	**27.3820**	**0.3454**						**60.7032**	**139.7971**	**25.0832**	**136.5303**
A. Fuel Combustion — Reference Approach	15284.3469											
Sectoral Approach	15345.0977	2.5793	0.3454						60.7032	139.7971	24.6395	136.5303
1. Energy Industries	10737.0218	0.2447	0.0928						30.1864	2.7480	0.7361	114.6896
2. Manufacturing Industries and Construction	563.0714	0.0273	0.0045						1.5266	0.5219	0.0587	5.1076
3. Transport	1699.7939	0.4614	0.2209						16.5386	103.2541	19.4675	2.1961
4. Other Sectors	2253.3852	1.8406	0.0248						11.9354	32.2832	4.1894	13.8256
5. Other	91.8254	0.0054	0.0023						0.5163	0.9899	0.1879	0.7113
B. Fugitive Emissions from Fuels	0.4382	24.8026	0.0000						0.0000	0.0000	0.4437	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4382	24.8026	0.0000						0.0000	0.0000	0.4437	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**733.1321**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.7064**	**3.2245**	**60.6455**	**0.6346**
A. Mineral Industry	583.4616								1.5838	1.4688	0.0143	0.5859
B. Chemical Industry	NO	NO	NO						NO	NO	0.0199	NO
C. Metal Industry	24.4250	NO	NO	NO	NO	NO	NO	NO	0.0794	1.0383	0.0315	0.0366

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	123.3910	NO	NO						0.0241	0.1356	50.1008	0.0120
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.8544	NO	0.0001	NO	NO	NO	NO	NO	0.0190	0.5819	0.8429	NO
H. Other									NO	NO	9.6360	NO
3. Agriculture	**0.1276**	**85.9778**	**6.9568**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		75.0132										
B. Manure Management		10.9646	2.7155								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			4.2413									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.1276											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-7197.7136**	**0.1179**	**0.1950**						**0.1091**	**4.0153**	**NE**	
A. Forest Land	-2173.9910	0.0001	0.0000						0.0001	0.0025	NE	
B. Cropland	-2078.6361	0.1178	0.1808						0.1090	4.0127	NE	
C. Grassland	-3109.7949	NE	NE						NE	NE	NE	
D. Wetlands	-17.4403	NE	NE						NE	NE	NE	
E. Settlements	114.6181	NE	0.0142						NE	NE	NE	
F. Other Land	164.1286	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-96.5980											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1013**	**70.4180**	**0.2422**						**0.1716**	**3.0038**	**1.7665**	**0.0060**
A. Solid Waste Disposal	NA, NO	48.1882							NA, NO	NA, NO	1.6703	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	17.1013	0.3511	0.0081						0.1716	3.0038	0.0663	0.0060
D. Wastewater Treatment and Discharge		21.8787	0.2341						NA, IE	NA, IE	0.0299	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	62.0927	0.0099	0.0020						0.2331	0.2215	0.1293	0.0197
Aviation	62.0927	0.0099	0.0020						0.2331	0.2215	0.1293	0.0197
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	143.2360											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.4356**									
Indirect CO_2	**112.0762**											

1994

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**8572.0914**	**177.0158**	**6.2405**	**NO**	**NO**	**NO**	**NO**	**NO**	**58.4139**	**143.4696**	**67.2505**	**100.3805**
1. Energy	**14410.2040**	**26.9855**	**0.2222**						**56.8378**	**135.3988**	**24.0078**	**99.8703**
A. Fuel Combustion Reference Approach	14372.7899											
Sectoral Approach	14409.7955	3.1141	0.2222						56.8378	135.3988	23.5809	99.8703
1. Energy Industries	9935.3786	0.1885	0.0868						28.4710	2.8047	0.7002	82.3832
2. Manufacturing Industries and Construction	828.8950	0.0229	0.0031						2.2333	0.5059	0.0787	1.6222
3. Transport	1485.6786	0.4168	0.1052						14.3065	96.5881	18.2035	1.7173
4. Other Sectors	2086.3753	2.4789	0.0257						11.4859	34.3147	4.3774	13.5587
5. Other	73.4680	0.0070	0.0015						0.3411	1.1855	0.2211	0.5889
B. Fugitive Emissions from Fuels	0.4085	23.8714	0.0000						0.0000	0.0000	0.4269	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4085	23.8714	0.0000						0.0000	0.0000	0.4269	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**552.8842**	**NO**	**0.0001**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.3435**	**2.8279**	**41.6403**	**0.5041**
A. Mineral Industry	441.6001								1.2292	1.1396	0.0115	0.4588
B. Chemical Industry	NO	NO	NO						NO	NO	0.0074	NO
C. Metal Industry	25.3289	NO	NO	NO	NO	NO	NO	NO	0.0824	1.0774	0.0322	0.0380
D. Non-energy Products From Fuels and Solvent Use	84.6033	NO	NO						0.0146	0.0820	32.7972	0.0073
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				NO	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.3519	NO	0.0001	NO	NO	NO	NO	NO	0.0173	0.5290	0.6145	NO
H. Other									NO	NO	8.1775	NO
3. Agriculture	**0.0537**	**83.5725**	**5.5782**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		73.0171										
B. Manure Management		10.5554	2.6254								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.9528									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.0537											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6408.1835**	**0.0664**	**0.2046**						**0.0608**	**2.2344**	**NE**	
A. Forest Land	-2088.6098	0.0025	0.0001						0.0016	0.0568	NE	
B. Cropland	-1821.2418	0.0639	0.1908						0.0592	2.1776	NE	
C. Grassland	-3104.1950	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	130.4883	NE	0.0136						NE	NE	NE	
F. Other Land	541.0720	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
G. Harvested Wood Products	-65.6972											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1330**	**66.3913**	**0.2354**						**0.1719**	**3.0085**	**1.6024**	**0.0060**
A. Solid Waste Disposal	NA, NO	48.3920							NA, NO	NA, NO	1.5088	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	17.1330	0.3517	0.0081						0.1719	3.0085	0.0664	0.0060
D. Wastewater Treatment and Discharge		17.6476	0.2272						NA, IE	NA, IE	0.0272	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	37.8235	0.0058	0.0012						0.1433	0.1323	0.0766	0.0120
Aviation	37.8235	0.0058	0.0012						0.1433	0.1323	0.0766	0.0120
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	157.4600											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.1585**									
Indirect CO_2	**73.5058**											

1995

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**5037.3423**	**166.7797**	**6.5648**	**4.5879**	**NO**	**NO**	**NO**	**NO**	**49.4809**	**142.9825**	**66.0356**	**59.5089**
1. Energy	**11122.6101**	**28.3907**	**0.1782**						**48.0824**	**134.3789**	**24.3552**	**59.0498**
A. Fuel Combustion Reference Approach	11081.1763											
Sectoral Approach	11122.1908	1.9351	0.1782						48.0824	134.3789	23.8791	59.0498
1. Energy Industries	6886.3081	0.1319	0.0496						19.4094	2.0544	0.5132	45.8616
2. Manufacturing Industries and Construction	463.9562	0.0155	0.0022						1.2541	0.3118	0.0458	1.1823
3. Transport	1482.0856	0.4276	0.1012						14.1154	100.4237	18.9204	1.6675
4. Other Sectors	2172.1646	1.3501	0.0230						12.8308	30.2159	4.1462	8.7335
5. Other	117.6762	0.0100	0.0021						0.4726	1.3732	0.2535	1.6050
B. Fugitive Emissions from Fuels	0.4194	26.4555	0.0000						0.0000	0.0000	0.4761	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4194	26.4555	0.0000						0.0000	0.0000	0.4761	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**448.9341**	**NO**	**0.0000**	**4.5879**	**NO**	**NO**	**NO**	**NO**	**1.1438**	**2.5468**	**40.2086**	**0.4530**
A. Mineral Industry	345.1199								1.0299	0.8868	0.0089	0.4070
B. Chemical Industry	NO	NO	NO						NO	NO	0.0051	NO
C. Metal Industry	26.2369	NO	NO	NO	NO	NO	NO	NO	0.0854	1.1166	0.0327	0.0394

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	76.4826	NO	NO						0.0132	0.0740	29.2180	0.0065
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				4.5879	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.0947	NO	0.0000	NO	NO	NO	NO	NO	0.0153	0.4695	0.4976	NO
H. Other									NO	NO	10.4463	NO
3. Agriculture	**0.0607**	**73.0154**	**5.9233**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		64.8267										
B. Manure Management		8.1887	2.4251								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.4982									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.0607											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6551.3841**	**0.0896**	**0.2251**						**0.0829**	**3.0513**	**NE**	
A. Forest Land	-2025.7694	0.0001	0.0000						0.0001	0.0033	NE	
B. Cropland	-1919.9573	0.0895	0.2119						0.0828	3.0480	NE	
C. Grassland	-3088.4744	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	106.9167	NE	0.0133						NE	NE	NE	
F. Other Land	392.7422	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-16.8419											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1216**	**65.2840**	**0.2382**						**0.1717**	**3.0055**	**1.4718**	**0.0060**
A. Solid Waste Disposal	NA, NO	48.3674							NA, NO	NA, NO	1.3847	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	17.1216	0.3514	0.0081						0.1717	3.0055	0.0664	0.0060
D. Wastewater Treatment and Discharge		16.5652	0.2301						NA, IE	NA, IE	0.0207	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	41.9184	0.0059	0.0013						0.1572	0.1403	0.0813	0.0133
Aviation	41.9184	0.0059	0.0013						0.1572	0.1403	0.0813	0.0133
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	230.0502											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.2001**									
Indirect CO_2	**65.3743**											

1996

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**5471.7141**	**163.8067**	**6.4228**	**5.1847**	**NO**	**NO**	**NO**	**NO**	**47.1636**	**143.3115**	**62.3036**	**58.3896**
1. Energy	**11342.9211**	**31.7196**	**0.1771**						**45.9385**	**135.5848**	**23.9485**	**58.0004**
A. Fuel Combustion Reference Approach	11277.9972											
Sectoral Approach	11342.4485	2.9641	0.1771						45.9385	135.5848	23.4325	58.0004
1. Energy Industries	7155.3361	0.1358	0.0477						20.0704	2.1843	0.5442	42.6638
2. Manufacturing Industries and Construction	377.6208	0.0138	0.0020						1.0218	0.2688	0.0383	1.2844
3. Transport	1451.6525	0.4125	0.0972						13.5802	95.3461	17.9605	1.5915
4. Other Sectors	2274.8811	2.3910	0.0279						10.8341	36.2020	4.6049	11.4920
5. Other	82.9580	0.0110	0.0023						0.4319	1.5836	0.2846	0.9687
B. Fugitive Emissions from Fuels	0.4726	28.7555	0.0000						0.0000	0.0000	0.5160	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4726	28.7555	0.0000						0.0000	0.0000	0.5160	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**407.6878**	**NO**	**0.0000**	**5.1847**	**NO**	**NO**	**NO**	**NO**	**0.9967**	**2.6314**	**36.9171**	**0.3831**
A. Mineral Industry	308.9247								0.8768	0.7855	0.0069	0.3371
B. Chemical Industry	NO	NO	NO						NO	NO	0.0046	NO
C. Metal Industry	26.7261	NO	NO	NO	NO	NO	NO	NO	0.0870	1.1375	0.0332	0.0401
D. Non-energy Products From Fuels and Solvent Use	70.9984	NO	NO						0.0119	0.0671	27.0276	0.0059
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				5.1847	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.0386	NO	0.0000	NO	NO	NO	NO	NO	0.0210	0.6414	0.4721	NO
H. Other									NO	NO	9.3728	NO
3. Agriculture	**0.0911**	**67.1143**	**5.7817**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		59.6473										
B. Manure Management		7.4670	2.5789								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.2028									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.0911											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6296.0942**	**0.0617**	**0.2293**						**0.0569**	**2.0930**	**NE**	
A. Forest Land	-2171.1779	0.0008	0.0000						0.0005	0.0190	NE	
B. Cropland	-1535.5834	0.0609	0.2166						0.0564	2.0740	NE	
C. Grassland	-2903.6947	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	101.5910	NE	0.0126						NE	NE	NE	
F. Other Land	208.9434	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
G. Harvested Wood Products	3.8273											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.1083**	**64.9110**	**0.2347**						**0.1716**	**3.0022**	**1.4379**	**0.0060**
A. Solid Waste Disposal	NA, NO	48.6714							NA, NO	NA, NO	1.3509	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	17.1083	0.3511	0.0081						0.1716	3.0022	0.0663	0.0060
D. Wastewater Treatment and Discharge		15.8885	0.2266						NA, IE	NA, IE	0.0208	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	65.8650	0.0048	0.0021						0.2563	0.1684	0.0900	0.0209
Aviation	65.8650	0.0048	0.0021						0.2563	0.1684	0.0900	0.0209
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	295.4440											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.1754**									
Indirect CO_2	**60.4993**											

1997

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
Total national emissions and sinks	**4563.4052**	**148.8324**	**6.4561**	**5.9997**	**NO**	**NO**	**NO**	**NO**	**43.7539**	**153.3698**	**49.5601**	**33.5716**
1. Energy	**10252.1997**	**26.0228**	**0.1506**						**42.2769**	**143.7241**	**25.2623**	**33.1004**
A. Fuel Combustion Reference Approach	10177.7235											
Sectoral Approach	10251.7346	2.3800	0.1506						42.2769	143.7241	25.2623	33.1004
1. Energy Industries	5615.5061	0.1108	0.0244						15.3208	1.8464	0.4607	21.3361
2. Manufacturing Industries and Construction	597.7916	0.0202	0.0027						1.6209	0.8510	0.0631	1.0385
3. Transport	1469.7744	0.4563	0.0966						14.0262	108.1520	20.3626	1.6281
4. Other Sectors	2496.0098	1.7851	0.0249						10.9306	31.6363	4.1483	8.3265
5. Other	72.6527	0.0077	0.0019						0.3784	1.2383	0.2275	0.7711
B. Fugitive Emissions from Fuels	0.4651	23.6428	0.0000						0.0000	0.0000	0.0000	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4651	23.6428	0.0000						0.0000	0.0000	0.0000	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**449.0073**	**NO**	**0.0000**	**5.9997**	**NO**	**NO**	**NO**	**NO**	**1.2065**	**2.9916**	**22.9531**	**0.4652**
A. Mineral Industry	373.6804								1.0765	0.9626	0.0096	0.4145
B. Chemical Industry	NO	NO	NO						NO	NO	0.0037	NO
C. Metal Industry	32.3806	NO	NO	NO	NO	NO	NO	NO	0.1054	1.3781	0.0401	0.0486

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	42.0075	NO	NO						0.0040	0.0227	14.1331	0.0020
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				5.9997	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.9389	NO	0.0000	NO	NO	NO	NO	NO	0.0205	0.6281	0.4268	NO
H. Other									NO	NO	8.3398	NO
3. Agriculture	**1.0992**	**57.4675**	**5.8498**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		51.4038										
B. Manure Management		6.0636	1.9891								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.8607									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	1.0992											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6155.9621**	**0.1075**	**0.2169**						**0.0995**	**3.6614**	**NE**	
A. Forest Land	-2213.0439	0.0003	0.0000						0.0002	0.0058	NE	
B. Cropland	-1451.2728	0.1073	0.2046						0.0993	3.6556	NE	
C. Grassland	-2771.9741	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	100.7954	NE	0.0123						NE	NE	NE	
F. Other Land	179.8504	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-0.3171											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.0610**	**65.2346**	**0.2388**						**0.1711**	**2.9928**	**1.3447**	**0.0060**
A. Solid Waste Disposal	NA, NO	48.1514							NA, NO	NA, NO	1.2600	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	17.0610	0.3501	0.0081						0.1711	2.9928	0.0661	0.0060
D. Wastewater Treatment and Discharge		16.7331	0.2307						NA, IE	NA, IE	0.0186	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	75.6418	0.0054	0.0024						0.3033	0.1927	0.1018	0.0240
Aviation	75.6418	0.0054	0.0024						0.3033	0.1927	0.1018	0.0240
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	291.0280											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.1696**									
Indirect CO_2	**32.0316**											

1998

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**2974.0273**	**141.4092**	**5.8657**	**7.4843**	**NO**	**NO**	**NO**	**NO**	**36.6451**	**129.5811**	**43.5191**	**26.3976**
1. Energy	**8794.4337**	**23.8261**	**0.1238**						**35.3240**	**120.7329**	**21.6983**	**25.9626**
A. Fuel Combustion Reference Approach	8723.0790											
Sectoral Approach	8794.0063	1.7011	0.1238						35.3240	120.7329	21.3067	25.9626
1. Energy Industries	4848.6438	0.0963	0.0192						13.1565	1.5895	0.4013	17.1551
2. Manufacturing Industries and Construction	559.0312	0.0160	0.0021						1.5075	0.5420	0.0551	0.9557
3. Transport	1273.6172	0.3898	0.0803						12.0909	92.0086	17.3252	1.4198
4. Other Sectors	2056.9647	1.1913	0.0204						8.2332	25.3604	3.3031	6.0518
5. Other	55.7495	0.0077	0.0018						0.3359	1.2324	0.2221	0.3803
B. Fugitive Emissions from Fuels	0.4274	22.1250	0.0000						0.0000	0.0000	0.3916	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4274	22.1250	0.0000						0.0000	0.0000	0.3916	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**373.4402**	**NO**	**0.0000**	**7.4843**	**NO**	**NO**	**NO**	**NO**	**1.0595**	**2.5186**	**20.4827**	**0.4289**
A. Mineral Industry	306.5335								0.9467	0.7826	0.0078	0.3842
B. Chemical Industry	NO	NO	NO						NO	NO	0.0042	NO
C. Metal Industry	28.6822	NO	NO	NO	NO	NO	NO	NO	0.0934	1.2208	0.0371	0.0431
D. Non-energy Products From Fuels and Solvent Use	37.5225	NO	NO						0.0033	0.0185	13.2383	0.0016
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				7.4843	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.7020	NO	0.0000	NO	NO	NO	NO	NO	0.0162	0.4967	0.3191	NO
H. Other									NO	NO	6.8761	NO
3. Agriculture	**0.2721**	**54.9812**	**5.2750**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		49.9020										
B. Manure Management		5.0792	1.9212								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.3538									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.2721											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6211.1275**	**0.0991**	**0.2258**						**0.0910**	**3.3472**	**NE**	
A. Forest Land	-2269.2309	0.0025	0.0001						0.0016	0.0571	NE	
B. Cropland	-1348.2104	0.0966	0.2133						0.0894	3.2900	NE	
C. Grassland	-2848.0605	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	99.0440	NE	0.0123						NE	NE	NE	
F. Other Land	176.6218	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
G. Harvested Wood Products	-21.2914											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**17.0087**	**62.5029**	**0.2412**						**0.1705**	**2.9824**	**1.3381**	**0.0060**
A. Solid Waste Disposal	NA, NO	47.5737							NA, NO	NA, NO	1.2568	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	17.0087	0.3490	0.0081						0.1705	2.9824	0.0659	0.0060
D. Wastewater Treatment and Discharge		14.5801	0.2331						NA, IE	NA, IE	0.0155	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	72.4923	0.0041	0.0023						0.2935	0.1739	0.0883	0.0230
Aviation	72.4923	0.0041	0.0023						0.2935	0.1739	0.0883	0.0230
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	269.0120											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0420**									
Indirect CO_2	**29.8264**											

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SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**1017.6408**	**135.7572**	**5.3377**	**8.5714**	NO	NO	NO	NO	**26.8247**	**88.6995**	**31.4470**	**13.4319**
1. Energy	**6849.6505**	**23.9519**	**0.0807**						**25.6213**	**79.8417**	**14.1048**	**13.0512**
A. Fuel Combustion Reference Approach	6778.3302											
Sectoral Approach	6849.2574	1.5474	0.0807						25.6213	79.8417	13.7041	13.0512
1. Energy Industries	3660.4440	0.0727	0.0088						9.7716	1.2800	0.3193	6.1391
2. Manufacturing Industries and Construction	491.5201	0.0132	0.0016						1.3246	0.5065	0.0485	0.4945
3. Transport	854.3647	0.2341	0.0506						8.0351	54.8341	10.3380	1.0022
4. Other Sectors	1798.5838	1.2211	0.0182						6.2210	22.3344	2.8415	5.0117
5. Other	44.3448	0.0063	0.0015						0.2691	0.8867	0.1568	0.4037
B. Fugitive Emissions from Fuels	0.3931	22.4045	0.0000						0.0000	0.0000	0.4007	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.3931	22.4045	0.0000						0.0000	0.0000	0.4007	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**336.6304**	**NO**	**0.0000**	**8.5714**	**NO**	**NO**	**NO**	**NO**	**0.9452**	**2.6426**	**16.1302**	**0.3746**
A. Mineral Industry	272.6662								0.8205	0.6987	0.0075	0.3257
B. Chemical Industry	NO	NO	NO						NO	NO	0.0035	NO
C. Metal Industry	31.7942	NO	NO	NO	NO	NO	NO	NO	0.1035	1.3533	0.0408	0.0478

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	31.5638	NO	NO						0.0024	0.0132	11.5886	0.0012
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				8.5714	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.6062	NO	0.0000	NO	NO	NO	NO	NO	0.0189	0.5773	0.2755	NO
H. Other									NO	NO	4.2144	NO
3. Agriculture	**0.0034**	**50.6255**	**4.7770**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		46.1688										
B. Manure Management		4.4567	1.7380								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.0390									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.0034											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6185.6213**	**0.0957**	**0.2388**						**0.0881**	**3.2394**	**NE**	
A. Forest Land	-2317.6962	0.0019	0.0001						0.0012	0.0427	NE	
B. Cropland	-1413.2991	0.0938	0.2272						0.0869	3.1967	NE	
C. Grassland	-2972.0904	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	111.8259	NE	0.0115						NE	NE	NE	
F. Other Land	416.7695	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-11.1310											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.9778**	**61.0841**	**0.2411**						**0.1702**	**2.9758**	**1.2120**	**0.0060**
A. Solid Waste Disposal	NA, NO	47.8085							NA, NO	NA, NO	1.1343	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.9778	0.3483	0.0080						0.1702	2.9758	0.0658	0.0060
D. Wastewater Treatment and Discharge		12.9273	0.2331						NA, IE	NA, IE	0.0119	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	72.4890	0.0040	0.0023						0.2907	0.1724	0.0877	0.0230
Aviation	72.4890	0.0040	0.0023						0.2907	0.1724	0.0877	0.0230
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	266.1120											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9359**									
Indirect CO_2	**26.1011**											

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SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent)					(kt)			
Total national emissions and sinks	**319.9055**	**132.8740**	**5.0286**	**10.4630**	**NO**	**NO**	**NO**	**NO**	**25.2402**	**85.5869**	**31.0555**	**9.5508**
1. Energy	**6124.4101**	**25.5546**	**0.0823**						**23.9680**	**78.6297**	**14.0072**	**9.0536**
A. Fuel Combustion Reference Approach	6059.2745											
Sectoral Approach	6124.0342	1.5292	0.0823						23.9680	78.6297	13.5732	9.0536
1. Energy Industries	3155.7517	0.0610	0.0069						8.4378	1.1590	0.2803	2.7544
2. Manufacturing Industries and Construction	537.2463	0.0123	0.0015						1.4419	0.2952	0.0496	0.4796
3. Transport	926.2051	0.2370	0.0561						8.9744	55.6587	10.5079	1.1795
4. Other Sectors	1478.8536	1.2154	0.0171						4.9689	20.8854	2.6198	4.4697
5. Other	25.9774	0.0036	0.0008						0.1449	0.6314	0.1156	0.1704
B. Fugitive Emissions from Fuels	0.3759	24.0254	0.0000						0.0000	0.0000	0.4341	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.3759	24.0254	0.0000						0.0000	0.0000	0.4341	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**308.5696**	**NO**	**0.0000**	**10.4630**	**NO**	**NO**	**NO**	**NO**	**1.0686**	**2.7459**	**15.8398**	**0.4912**
A. Mineral Industry	240.0428								0.9286	0.5791	0.0067	0.4358
B. Chemical Industry	NO	NO	NO						NO	NO	0.0065	NO
C. Metal Industry	36.2689	NO	NO	NO	NO	NO	NO	NO	0.1181	1.5438	0.0462	0.0545
D. Non-energy Products From Fuels and Solvent Use	31.3591	NO	NO						0.0019	0.0107	11.6111	0.0009
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				10.4630	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.8987	NO	0.0000	NO	NO	NO	NO	NO	0.0200	0.6124	0.4085	NO
H. Other									NO	NO	3.7608	NO
3. Agriculture	**0.4397**	**46.8112**	**4.4614**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		43.4275										
B. Manure Management		3.3837	1.5597								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.9017									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.4397											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-6130.4573**	**0.0365**	**0.2434**						**0.0338**	**1.2428**	**NE**	
A. Forest Land	-2288.3306	0.0001	0.0000						0.0000	0.0015	NE	
B. Cropland	-1284.6926	0.0364	0.2340						0.0337	1.2413	NE	
C. Grassland	-2844.3351	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	100.1768	NE	0.0094						NE	NE	NE	
F. Other Land	170.1387	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
G. Harvested Wood Products	16.5854											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.9434**	**60.4717**	**0.2415**						**0.1698**	**2.9685**	**1.2085**	**0.0060**
A. Solid Waste Disposal	NA, NO	46.7803							NA, NO	NA, NO	1.1318	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.9434	0.3476	0.0080						0.1698	2.9685	0.0656	0.0060
D. Wastewater Treatment and Discharge		13.3438	0.2334						NA, IE	NA, IE	0.0111	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	66.2279	0.0043	0.0021						0.2728	0.1738	0.0800	0.0210
Aviation	66.2279	0.0043	0.0021						0.2728	0.1738	0.0800	0.0210
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	272.3720											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.8680**									
Indirect CO_2	**26.4431**											

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SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
Total national emissions and sinks	**1183.6537**	**132.9496**	**5.5809**	**12.8513**	**NO**	**NO**	**NO**	**NO**	**27.5266**	**89.1888**	**33.2102**	**9.1867**
1. Energy	**6731.0024**	**25.2265**	**0.0885**						**26.2808**	**81.6619**	**14.6544**	**8.7167**
A. Fuel Combustion — Reference Approach	6670.0891											
Sectoral Approach	6730.5931	1.4057	0.0885						26.2808	81.6619	14.2266	8.7167
1. Energy Industries	3677.7189	0.0726	0.0080						9.8425	1.4358	0.3317	2.5279
2. Manufacturing Industries and Construction	618.7855	0.0150	0.0020						1.6750	0.3269	0.0567	0.6265
3. Transport	989.3629	0.2515	0.0611						9.7695	59.3163	11.2030	1.2904
4. Other Sectors	1416.7615	1.0618	0.0163						4.8004	19.8497	2.5041	4.0549
5. Other	27.9644	0.0047	0.0012						0.1934	0.7332	0.1312	0.2170
B. Fugitive Emissions from Fuels	0.4092	23.8208	0.0000						0.0000	0.0000	0.4278	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.4092	23.8208	0.0000						0.0000	0.0000	0.4278	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**311.3929**	**NO**	**0.0000**	**12.8513**	**NO**	**NO**	**NO**	**NO**	**1.0294**	**2.8564**	**17.4602**	**0.4640**
A. Mineral Industry	237.3637								0.8809	0.5760	0.0066	0.4048
B. Chemical Industry	NO	NO	NO						NO	NO	0.0080	NO
C. Metal Industry	38.6274	NO	NO	NO	NO	NO	NO	NO	0.1257	1.6441	0.0500	0.0580

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	34.6288	NO	NO						0.0024	0.0134	12.8531	0.0012
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				12.8513	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.7730	NO	0.0000	NO	NO	NO	NO	NO	0.0203	0.6229	0.3514	NO
H. Other									NO	NO	4.1911	NO
3. Agriculture	**0.1496**	**47.6273**	**4.9731**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		44.2135										
B. Manure Management		3.4138	1.5863								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.3868									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.1496											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-5875.8873**	**0.0511**	**0.2744**						**0.0461**	**1.6939**	**NE**	
A. Forest Land	-2254.6081	0.0042	0.0002						0.0027	0.0967	NE	
B. Cropland	-1106.4081	0.0469	0.2659						0.0434	1.5972	NE	
C. Grassland	-2755.9956	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	67.0898	NE	0.0083						NE	NE	NE	
F. Other Land	170.1387	NE	NE						NE	NE	NE	
G. Harvested Wood Products	3.8960											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.9961**	**60.0447**	**0.2448**						**0.1703**	**2.9765**	**1.0955**	**0.0060**
A. Solid Waste Disposal	NA, NO	45.4984							NA, NO	NA, NO	1.0191	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.9961	0.3486	0.0080						0.1703	2.9765	0.0658	0.0060
D. Wastewater Treatment and Discharge		14.1977	0.2368						NA, IE	NA, IE	0.0106	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	61.8894	0.0039	0.0020						0.2403	0.1649	0.0728	0.0196
Aviation	61.8894	0.0039	0.0020						0.2403	0.1649	0.0728	0.0196
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	282.2280											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9657**									
Indirect CO_2	**29.0498**											

2002

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**1832.4957**	**134.7342**	**5.7628**	**16.8928**	**NO**	**NO**	**NO**	**NO**	**28.7971**	**108.1723**	**38.5332**	**10.3037**
1. Energy	**6405.6634**	**27.6567**	**0.1182**						**27.4453**	**102.8280**	**18.3764**	**9.7717**
A. Fuel Combustion Reference Approach	6344.6150											
Sectoral Approach	6405.2733	1.7743	0.1182						27.4453	102.8280	17.9066	9.7717
1. Energy Industries	2933.2101	0.0614	0.0069						7.8618	1.2633	0.2704	1.9697
2. Manufacturing Industries and Construction	431.7808	0.0103	0.0013						1.1589	0.2403	0.0403	0.4309
3. Transport	1261.6952	0.3243	0.0892						12.5249	76.6112	14.4651	1.6186
4. Other Sectors	1743.4526	1.3701	0.0193						5.6854	23.6946	2.9582	5.4030
5. Other	35.1345	0.0081	0.0015						0.2143	1.0185	0.1726	0.3494
B. Fugitive Emissions from Fuels	0.3901	25.8825	0.0000						0.0000	0.0000	0.4697	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	0.3901	25.8825	0.0000						0.0000	0.0000	0.4697	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**360.0955**	**NO**	**0.0000**	**16.8928**	**NO**	**NO**	**NO**	**NO**	**1.1728**	**2.0366**	**19.0027**	**0.5261**
A. Mineral Industry	302.8397								1.0903	0.7351	0.0083	0.4942
B. Chemical Industry	NO	NO	NO						NO	NO	0.0104	NO
C. Metal Industry	20.5030	NO	NO	NO	NO	NO	NO	NO	0.0667	0.8725	0.0263	0.0308
D. Non-energy Products From Fuels and Solvent Use	36.0221	NO	NO						0.0021	0.0117	13.7991	0.0010
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				16.8928	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.7307	NO	0.0000	NO	NO	NO	NO	NO	0.0136	0.4172	0.3321	NO
H. Other									NO	NO	4.8266	NO
3. Agriculture	**0.0470**	**48.7256**	**5.1150**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		45.1458										
B. Manure Management		3.5798	1.6001								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.5149									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.0470											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-4950.2508**	**0.0108**	**0.2786**						**0.0093**	**0.3423**	**NE**	
A. Forest Land	-2248.5141	0.0023	0.0001						0.0015	0.0519	NE	
B. Cropland	-696.2856	0.0085	0.2701						0.0079	0.2904	NE	
C. Grassland	-2512.2749	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	67.0898	NE	0.0083						NE	NE	NE	
F. Other Land	447.8610	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
G. Harvested Wood Products	-8.1271											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.9406**	**58.3411**	**0.2510**						**0.1697**	**2.9653**	**1.1541**	**0.0060**
A. Solid Waste Disposal	NA, NO	44.3221							NA, NO	NA, NO	1.0781	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.9406	0.3474	0.0080						0.1697	2.9653	0.0656	0.0060
D. Wastewater Treatment and Discharge		13.6716	0.2429						NA, IE	NA, IE	0.0104	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	62.0647	0.0036	0.0020						0.2505	0.1652	0.0671	0.0197
Aviation	62.0647	0.0036	0.0020						0.2505	0.1652	0.0671	0.0197
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	324.9000											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0006**									
Indirect CO_2	**31.0887**											

2003

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
Total national emissions and sinks	**2473.1835**	**131.7616**	**5.0466**	**23.6694**	**NO**	**NO**	**0.0000**	**NO**	**31.1703**	**128.8276**	**43.1876**	**12.3242**
1. Energy	**7080.9417**	**29.3214**	**0.1209**						**29.7886**	**123.0619**	**21.7330**	**11.7861**
A. Fuel Combustion — Reference Approach	7011.3606											
Sectoral Approach	7079.8825	2.2629	0.1209						29.7886	123.0619	21.1947	11.7861
1. Energy Industries	3036.7432	0.0626	0.0069						8.1426	1.3033	0.2802	1.4374
2. Manufacturing Industries and Construction	456.6402	0.0103	0.0013						1.2246	0.2474	0.0418	0.4519
3. Transport	1477.1916	0.3811	0.0873						14.4970	90.8456	17.1547	1.9169
4. Other Sectors	2082.5048	1.8054	0.0246						5.7822	30.2158	3.6405	7.7279
5. Other	26.8027	0.0036	0.0008						0.1422	0.4499	0.0775	0.2519
B. Fugitive Emissions from Fuels	1.0592	27.0585	0.0000						0.0000	0.0000	0.5383	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.0592	27.0585	0.0000						0.0000	0.0000	0.5383	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**388.2276**	**NO**	**0.0000**	**23.6694**	**NO**	**NO**	**0.0000**	**NO**	**1.2110**	**2.7524**	**20.1475**	**0.5321**
A. Mineral Industry	311.0548								1.0778	0.7592	0.0091	0.4777
B. Chemical Industry	NO	NO	NO						NO	NO	0.0123	NO
C. Metal Industry	35.4283	NO	NO	NO	NO	NO	NO	NO	0.1153	1.5074	0.0456	0.0532

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	40.8564	NO	NO						0.0026	0.0145	14.8566	0.0013
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				23.6694	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.8881	NO	0.0000	NO	NO	NO	0.0000	NO	0.0154	0.4712	0.4037	NO
H. Other									NO	NO	4.8202	NO
3. Agriculture	**0.2381**	**44.5785**	**4.3955**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		41.2451										
B. Manure Management		3.3334	1.5214								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.8741									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.2381											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-5013.0963**	**0.0026**	**0.2876**						**0.0017**	**0.0614**	**NE**	
A. Forest Land	-2250.9181	0.0025	0.0001						0.0016	0.0568	NE	
B. Cropland	-646.0039	0.0001	0.2801						0.0001	0.0046	NE	
C. Grassland	-2277.6455	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	67.8615	NE	0.0073						NE	NE	NE	
F. Other Land	152.1220	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-58.5123											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.8724**	**57.8591**	**0.2426**						**0.1689**	**2.9519**	**1.3071**	**0.0060**
A. Solid Waste Disposal	NA, NO	42.8091							NA, NO	NA, NO	1.2315	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.8724	0.3460	0.0080						0.1689	2.9519	0.0653	0.0060
D. Wastewater Treatment and Discharge		14.7040	0.2346						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	70.1110	0.0035	0.0023						0.2887	0.1786	0.0705	0.0222
Aviation	70.1110	0.0035	0.0023						0.2887	0.1786	0.0705	0.0222
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	373.5760											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.8625**									
Indirect CO_2	**33.5726**											

2004

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**4046.3301**	**130.4966**	**5.8631**	**31.0742**	**NO**	**NO**	**0.0000**	**NO**	**33.2717**	**131.3437**	**56.0942**	**11.1911**
1. Energy	**7540.7092**	**31.3414**	**0.1324**						**31.7397**	**125.1157**	**22.8140**	**10.5951**
A. Fuel Combustion Reference Approach	7473.8274											
Sectoral Approach	7539.6047	1.9716	0.1324						31.7397	125.1157	21.9447	10.5951
1. Energy Industries	3107.0816	0.0639	0.0071						8.3336	1.3408	0.2872	1.2771
2. Manufacturing Industries and Construction	471.0767	0.0127	0.0016						1.2718	0.3512	0.0458	0.6201
3. Transport	1668.7316	0.4094	0.1017						16.4341	97.7586	18.4736	2.1947
4. Other Sectors	2258.9904	1.4822	0.0210						5.4797	25.1063	3.0344	6.3768
5. Other	33.7244	0.0034	0.0011						0.2205	0.5588	0.1037	0.1264
B. Fugitive Emissions from Fuels	1.1045	29.3699	0.0000						0.0000	0.0000	0.8693	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.1045	29.3699	0.0000						0.0000	0.0000	0.8693	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**458.6192**	**NO**	**0.0001**	**31.0742**	**NO**	**NO**	**0.0000**	**NO**	**1.3599**	**3.1110**	**31.8863**	**0.5901**
A. Mineral Industry	353.3699								1.2047	0.8754	0.0104	0.5252
B. Chemical Industry	NO	NO	NO						NO	NO	0.0118	NO
C. Metal Industry	40.5084	NO	NO	NO	NO	NO	NO	NO	0.1318	1.7236	0.0522	0.0608
D. Non-energy Products From Fuels and Solvent Use	63.7753	NO	NO						0.0082	0.0459	25.2292	0.0041
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				31.0742	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.9656	NO	0.0001	NO	NO	NO	0.0000	NO	0.0152	0.4661	0.4389	NO
H. Other									NO	NO	6.1437	NO
3. Agriculture	**0.3669**	**41.7331**	**5.1959**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		38.4913										
B. Manure Management		3.2418	1.4730								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.7229									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.3669											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-3969.9582**	**0.0085**	**0.2856**						**0.0060**	**0.2160**	**NE**	
A. Forest Land	-2315.5844	0.0066	0.0004						0.0042	0.1492	NE	
B. Cropland	524.5167	0.0020	0.2785						0.0018	0.0668	NE	
C. Grassland	-2316.5028	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NE	0.0067						NE	NE	NE	
F. Other Land	150.8347	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
G. Harvested Wood Products	-66.8962											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.5930**	**57.4136**	**0.2491**						**0.1661**	**2.9010**	**1.3939**	**0.0059**
A. Solid Waste Disposal	NA, NO	42.2062							NA, NO	NA, NO	1.3194	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.5930	0.3402	0.0078						0.1661	2.9010	0.0642	0.0059
D. Wastewater Treatment and Discharge		14.8673	0.2413						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	67.3304	0.0035	0.0022						0.2767	0.1815	0.0622	0.0213
Aviation	67.3304	0.0035	0.0022						0.2767	0.1815	0.0622	0.0213
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	307.6800											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0118**									
Indirect CO_2	**56.4699**											

2005

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**3544.7338**	**132.1289**	**5.9046**	**42.1522**	**NO**	**NO**	**0.0000**	**NO**	**34.5186**	**133.8851**	**59.3127**	**10.9459**
1. Energy	**7811.9510**	**33.0891**	**0.1428**						**32.7063**	**127.2978**	**23.1601**	**10.2432**
A. Fuel Combustion Reference Approach	7744.7258											
Sectoral Approach	7810.8291	2.0717	0.1428						32.7063	127.2978	22.3811	10.2432
1. Energy Industries	3229.4503	0.0660	0.0072						8.6604	1.3853	0.2983	1.1727
2. Manufacturing Industries and Construction	603.9661	0.0145	0.0018						1.6266	0.3974	0.0569	0.5378
3. Transport	1723.9901	0.4222	0.1122						17.1134	100.5947	19.0104	2.2795
4. Other Sectors	2218.7801	1.5662	0.0206						5.0944	24.5675	2.9510	6.1272
5. Other	34.6426	0.0028	0.0010						0.2115	0.3529	0.0646	0.1261
B. Fugitive Emissions from Fuels	1.1219	31.0174	0.0000						0.0000	0.0000	0.7790	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.1219	31.0174	0.0000						0.0000	0.0000	0.7790	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**556.3237**	**NO**	**0.0001**	**42.1522**	**NO**	**NO**	**0.0000**	**NO**	**1.6376**	**3.3632**	**34.6011**	**0.6968**
A. Mineral Industry	444.8424								1.4802	1.1266	0.0133	0.6300
B. Chemical Industry	NO	NO	NO						NO	NO	0.0149	NO
C. Metal Industry	41.9358	NO	NO	NO	NO	NO	NO	NO	0.1364	1.7839	0.0545	0.0630

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	68.4829	NO	NO						0.0077	0.0431	27.3110	0.0038
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				42.1522	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.0626	NO	0.0001	NO	NO	NO	0.0000	NO	0.0134	0.4096	0.4830	NO
H. Other									NO	NO	6.7243	NO
3. Agriculture	**0.1739**	**40.5015**	**5.2477**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		37.0747										
B. Manure Management		3.4267	1.5707								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.6770									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.1739											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-4840.2625**	**0.0100**	**0.2539**						**0.0091**	**0.3328**	**NE**	
A. Forest Land	-2390.3683	0.0006	0.0000						0.0004	0.0142	NE	
B. Cropland	-489.2386	0.0093	0.2472						0.0087	0.3185	NE	
C. Grassland	-2240.7618	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NE	0.0067						NE	NE	NE	
F. Other Land	281.6495	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-55.2171											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.5476**	**58.5284**	**0.2602**						**0.1656**	**2.8914**	**1.5515**	**0.0059**
A. Solid Waste Disposal	NA, NO	42.5718							NA, NO	NA, NO	1.4772	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.5476	0.3392	0.0078						0.1656	2.8914	0.0640	0.0059
D. Wastewater Treatment and Discharge		15.6174	0.2524						NA, IE	NA, IE	0.0104	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	67.6488	0.0035	0.0022						0.2800	0.1836	0.0628	0.0214
Aviation	67.6488	0.0035	0.0022						0.2800	0.1836	0.0628	0.0214
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	307.3920											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0264**									
Indirect CO_2	**61.1468**											

2006

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**2637.7945**	**126.7626**	**5.5875**	**54.7020**	**0.0231**	**NO**	**0.0000**	**NO**	**32.6280**	**129.0389**	**63.1443**	**11.2334**
1. Energy	**7069.0187**	**29.5995**	**0.1486**						**30.6692**	**122.9391**	**22.0307**	**10.5018**
A. Fuel Combustion Reference Approach	6993.5519											
Sectoral Approach	7067.7927	2.2692	0.1486						30.6692	122.9391	21.3514	10.5018
1. Energy Industries	2492.9310	0.0517	0.0057						6.6886	1.0976	0.2317	0.8876
2. Manufacturing Industries and Construction	668.5271	0.0148	0.0018						1.7956	0.3704	0.0609	0.5672
3. Transport	1651.9002	0.3897	0.1168						16.8128	93.4424	17.6745	2.2771
4. Other Sectors	2203.5166	1.8096	0.0229						5.0878	27.5881	3.3028	6.4610
5. Other	50.9179	0.0034	0.0014						0.2844	0.4406	0.0815	0.3090
B. Fugitive Emissions from Fuels	1.2260	27.3303	0.0000						0.0000	0.0000	0.6793	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2260	27.3303	0.0000						0.0000	0.0000	0.6793	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**654.1156**	**NO**	**0.0001**	**54.7020**	**0.0231**	**NO**	**0.0000**	**NO**	**1.7861**	**2.9378**	**39.4337**	**0.7256**
A. Mineral Industry	543.7505								1.6749	1.3863	0.0164	0.6789
B. Chemical Industry	NO	NO	NO						NO	NO	0.0130	NO
C. Metal Industry	27.0182	NO	NO	NO	NO	NO	NO	NO	0.0879	1.1492	0.0355	0.0406
D. Non-energy Products From Fuels and Solvent Use	82.3885	NO	NO						0.0124	0.0697	33.3990	0.0062
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				54.7020	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.9584	NO	0.0001	NO	0.0231	NO	0.0000	NO	0.0109	0.3326	0.4356	NO
H. Other									NO	NO	5.5342	NO
3. Agriculture	**0.1460**	**39.3774**	**4.9614**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		35.8795										
B. Manure Management		3.4979	1.6153								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.3461									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.1460											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-5101.9787**	**0.0105**	**0.2222**						**0.0078**	**0.2819**	**NE**	
A. Forest Land	-2347.2587	0.0068	0.0004						0.0043	0.1540	NE	
B. Cropland	-608.3183	0.0038	0.2152						0.0035	0.1279	NE	
C. Grassland	-2227.5442	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	53.6737	NE	0.0067						NE	NE	NE	
F. Other Land	70.2812	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
G. Harvested Wood Products	-42.8125											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.4929**	**57.7751**	**0.2553**						**0.1650**	**2.8801**	**1.6799**	**0.0059**
A. Solid Waste Disposal	NA, NO	42.4729							NA, NO	NA, NO	1.6057	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.4929	0.3380	0.0078						0.1650	2.8801	0.0637	0.0059
D. Wastewater Treatment and Discharge		14.9642	0.2475						NA, IE	NA, IE	0.0104	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	75.9610	0.0040	0.0025						0.3208	0.2037	0.0722	0.0241
Aviation	75.9610	0.0040	0.0025						0.3208	0.2037	0.0722	0.0241
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	361.4360											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9734**									
Indirect CO_2	**74.4362**											

2007

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
Total national emissions and sinks	**3032.8304**	**119.9505**	**3.6330**	**69.8086**	**0.0231**	**NO**	**0.0000**	**NO**	**35.0645**	**129.1874**	**64.1206**	**9.2497**
1. Energy	**7208.6350**	**30.8524**	**0.1495**						**32.5239**	**120.7018**	**22.2713**	**8.3615**
A. Fuel Combustion Reference Approach	7129.2618											
Sectoral Approach	7207.3774	1.7986	0.1495						32.5239	120.7018	21.4002	8.3615
1. Energy Industries	2890.4481	0.0592	0.0063						7.7534	1.2656	0.2688	0.5638
2. Manufacturing Industries and Construction	831.1775	0.0169	0.0019						2.2278	0.4592	0.0748	0.3809
3. Transport	1757.8033	0.4066	0.1216						17.9824	96.8558	18.3272	2.4643
4. Other Sectors	1666.7458	1.3113	0.0178						4.1758	21.4422	2.6024	4.7091
5. Other	61.2028	0.0046	0.0019						0.3845	0.6790	0.1271	0.2434
B. Fugitive Emissions from Fuels	1.2577	29.0538	0.0000						0.0000	0.0000	0.8710	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2577	29.0538	0.0000						0.0000	0.0000	0.8710	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**901.0373**	**NO**	**NO**	**69.8086**	**0.0231**	**NO**	**0.0000**	**NO**	**2.3331**	**4.0697**	**39.7471**	**0.8823**
A. Mineral Industry	776.1316								2.1837	2.0250	0.0244	0.8179
B. Chemical Industry	NO	NO	NO						NO	NO	0.0139	NO
C. Metal Industry	38.6127	NO	NO	NO	NO	NO	NO	NO	0.1256	1.6426	0.0508	0.0580

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	85.3456	NO	NO						0.0130	0.0732	35.2553	0.0065
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				69.8086	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.9474	NO	NO	NO	0.0231	NO	0.0000	NO	0.0107	0.3289	0.4306	NO
H. Other									NO	NO	3.9720	NO
3. Agriculture	**0.2631**	**31.4767**	**3.0116**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		28.9885										
B. Manure Management		2.4883	1.2329								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			1.7788									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.2631											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-5093.5290**	**0.0650**	**0.2272**						**0.0433**	**1.5498**	**NE**	
A. Forest Land	-2445.1609	0.0589	0.0033						0.0376	1.3419	NE	
B. Cropland	-561.2881	0.0061	0.2178						0.0056	0.2079	NE	
C. Grassland	-2164.3852	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	49.2742	NE	0.0061						NE	NE	NE	
F. Other Land	70.2812	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-42.2503											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.4239**	**57.5563**	**0.2447**						**0.1642**	**2.8661**	**2.1023**	**0.0059**
A. Solid Waste Disposal	NA, NO	42.5927							NA, NO	NA, NO	2.0285	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.4239	0.3365	0.0078						0.1642	2.8661	0.0634	0.0059
D. Wastewater Treatment and Discharge		14.6272	0.2369						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	79.8999	0.0028	0.0026						0.3447	0.1871	0.0698	0.0253
Aviation	79.8999	0.0028	0.0026						0.3447	0.1871	0.0698	0.0253
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	304.6560											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.6086**									
Indirect CO_2	**78.5091**											

2008

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**4237.7119**	**119.3775**	**5.6159**	**84.6748**	**0.0288**	**NO**	**0.0000**	**NO**	**37.5679**	**134.1375**	**58.5079**	**15.7014**
1. Energy	**7797.1121**	**30.7646**	**0.1602**						**34.8468**	**126.1410**	**23.5029**	**14.7669**
A. Fuel Combustion Reference Approach	7708.5089											
Sectoral Approach	7795.8374	1.8660	0.1602						34.8468	126.1410	22.3546	14.7669
1. Energy Industries	3292.3392	0.0691	0.0118						8.9779	1.4975	0.3003	4.5794
2. Manufacturing Industries and Construction	914.5002	0.0349	0.0047						2.5416	0.7142	0.1050	2.6179
3. Transport	1848.7566	0.4221	0.1233						18.8620	101.0306	19.1218	2.6186
4. Other Sectors	1677.3708	1.3356	0.0186						4.1047	22.2423	2.7039	4.5404
5. Other	62.8705	0.0042	0.0017						0.3607	0.6564	0.1236	0.4105
B. Fugitive Emissions from Fuels	1.2748	28.8986	0.0000						0.0000	0.0000	1.1483	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2748	28.8986	0.0000						0.0000	0.0000	1.1483	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**978.6462**	**NO**	**NO**	**84.6748**	**0.0288**	**NO**	**0.0000**	**NO**	**2.5297**	**4.1271**	**32.6079**	**0.9287**
A. Mineral Industry	874.7129								2.3984	2.3142	0.0277	0.8718
B. Chemical Industry	NO	NO	NO						NO	NO	0.0122	NO
C. Metal Industry	35.4118	NO	NO	NO	NO	NO	NO	NO	0.1152	1.5064	0.0465	0.0532
D. Non-energy Products From Fuels and Solvent Use	67.5356	NO	NO						0.0075	0.0427	26.9460	0.0037
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				84.6748	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.9859	NO	NO	NO	0.0288	NO	0.0000	NO	0.0086	0.2638	0.4481	NO
H. Other									NO	NO	5.1274	NO
3. Agriculture	**0.8505**	**30.0773**	**4.9854**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		27.6304										
B. Manure Management		2.4469	1.2103								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.7751									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.8505											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-4555.2731**	**0.0311**	**0.2246**						**0.0276**	**1.0136**	**NE**	
A. Forest Land	-2447.9362	0.0041	0.0002						0.0026	0.0933	NE	
B. Cropland	-517.9302	0.0270	0.2183						0.0250	0.9203	NE	
C. Grassland	-1883.4658	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	49.2742	NE	0.0061						NE	NE	NE	
F. Other Land	291.0044	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
G. Harvested Wood Products	-46.2195											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3761**	**58.5045**	**0.2457**						**0.1637**	**2.8558**	**2.3971**	**0.0059**
A. Solid Waste Disposal	NA, NO	43.3686							NA, NO	NA, NO	2.3236	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.3761	0.3354	0.0077						0.1637	2.8558	0.0632	0.0059
D. Wastewater Treatment and Discharge		14.8004	0.2379						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	89.2738	0.0017	0.0029						0.3939	0.1807	0.0752	0.0283
Aviation	89.2738	0.0017	0.0029						0.3939	0.1807	0.0752	0.0283
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	352.4520											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9767**									
Indirect CO_2	**60.2670**											

2009

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent			(kt)					
Total national emissions and sinks	**5169.5702**	**115.6662**	**4.9233**	**93.2489**	**0.0288**	**NO**	**0.0000**	**NO**	**37.5550**	**131.2280**	**52.8153**	**19.4449**
1. Energy	**8606.6397**	**25.9034**	**0.1613**						**36.1288**	**125.9630**	**23.3804**	**18.9374**
A. Fuel Combustion Reference Approach	8524.5226											
Sectoral Approach	8605.3665	1.9861	0.1613						36.1288	125.9630	22.2479	18.9374
1. Energy Industries	4452.7046	0.0914	0.0185						12.2184	1.9199	0.3947	9.5045
2. Manufacturing Industries and Construction	507.6894	0.0221	0.0031						1.4245	0.4309	0.0619	1.7887
3. Transport	1807.3330	0.4302	0.1199						18.3053	100.3654	18.9797	2.5152
4. Other Sectors	1824.7201	1.4415	0.0195						4.1212	23.0987	2.7846	5.0117
5. Other	12.9193	0.0010	0.0003						0.0593	0.1482	0.0271	0.1172
B. Fugitive Emissions from Fuels	1.2732	23.9173	0.0000						0.0000	0.0000	1.1325	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2732	23.9173	0.0000						0.0000	0.0000	1.1325	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**466.2423**	**NO**	**NO**	**93.2489**	**0.0288**	**NO**	**0.0000**	**NO**	**1.2535**	**2.0770**	**27.2539**	**0.5017**
A. Mineral Industry	389.8573								1.1819	0.9974	0.0122	0.4733
B. Chemical Industry	NO	NO	NO						NO	NO	0.0100	NO
C. Metal Industry	17.0619	NO	NO	NO	NO	NO	NO	NO	0.0555	0.7255	0.0227	0.0256

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	58.6232	NO	NO						0.0056	0.0316	23.4326	0.0028
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				93.2489	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.6998	NO	NO	NO	0.0288	NO	0.0000	NO	0.0105	0.3225	0.3181	NO
H. Other									NO	NO	3.4583	NO
3. Agriculture	**0.5864**	**31.5015**	**4.3026**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		28.7094										
B. Manure Management		2.7921	1.3661								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.9365									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	0.5864											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-3920.2377**	**0.0133**	**0.2274**						**0.0095**	**0.3406**	**NE**	
A. Forest Land	-2511.3674	0.0100	0.0006						0.0064	0.2276	NE	
B. Cropland	-373.2147	0.0033	0.2212						0.0031	0.1130	NE	
C. Grassland	-1123.9641	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	45.5694	NE	0.0057						NE	NE	NE	
F. Other Land	79.9357	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-37.1965											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3396**	**58.2481**	**0.2320**						**0.1633**	**2.8474**	**2.1810**	**0.0059**
A. Solid Waste Disposal	NA, NO	44.6029							NA, NO	NA, NO	2.1076	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.3396	0.3346	0.0077						0.1633	2.8474	0.0631	0.0059
D. Wastewater Treatment and Discharge		13.3105	0.2243						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	82.6571	0.0018	0.0027						0.3672	0.1729	0.0709	0.0262
Aviation	82.6571	0.0018	0.0027						0.3672	0.1729	0.0709	0.0262
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	362.1000											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.8514**									
Indirect CO_2	**52.2514**											

2010

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**6359.5912**	**116.5438**	**5.5238**	**113.4282**	**0.0403**	**NO**	**0.0000**	**NO**	**40.5575**	**130.3057**	**57.0391**	**19.0192**
1. Energy	**9148.1087**	**25.3241**	**0.1594**						**39.0509**	**125.3956**	**23.0859**	**18.4660**
A. Fuel Combustion Reference Approach	9065.9930											
Sectoral Approach	9146.8340	2.1313	0.1594						39.0509	125.3956	22.2089	18.4660
1. Energy Industries	4589.7895	0.0965	0.0180						12.5571	2.0615	0.4139	8.4258
2. Manufacturing Industries and Construction	539.5862	0.0228	0.0032						1.5074	0.4630	0.0644	1.7348
3. Transport	2007.4377	0.4354	0.1187						20.4225	100.2581	18.9936	2.9510
4. Other Sectors	1985.9921	1.5743	0.0190						4.4650	22.4025	2.7027	5.0653
5. Other	24.0285	0.0022	0.0006						0.0989	0.2105	0.0343	0.2890
B. Fugitive Emissions from Fuels	1.2747	23.1928	0.0000						0.0000	0.0000	0.8770	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.2747	23.1928	0.0000						0.0000	0.0000	0.8770	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**490.8096**	**NO**	**NO**	**113.4282**	**0.0403**	**NO**	**0.0000**	**NO**	**1.3392**	**1.9101**	**31.9434**	**0.5474**
A. Mineral Industry	412.7424								1.2872	1.0448	0.0126	0.5294
B. Chemical Industry	NO	NO	NO						NO	NO	0.0143	NO
C. Metal Industry	9.6985	NO	NO	NO	NO	NO	NO	NO	0.0315	0.4121	0.0128	0.0145
D. Non-energy Products From Fuels and Solvent Use	67.4640	NO	NO						0.0069	0.0392	27.0436	0.0034
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				113.4282	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.9046	NO	NO	NO	0.0403	NO	0.0000	NO	0.0135	0.4140	0.4112	NO
H. Other									NO	NO	4.4489	NO
3. Agriculture	**1.7443**	**31.5606**	**4.8959**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		28.5047										
B. Manure Management		3.0558	1.4165								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.4794									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	1.7443											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-3297.3873**	**0.0058**	**0.2253**						**0.0044**	**0.1587**	**NE**	
A. Forest Land	-2489.6089	0.0035	0.0002						0.0022	0.0795	NE	
B. Cropland	-399.2688	0.0023	0.2194						0.0022	0.0792	NE	
C. Grassland	-555.7508	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	45.5885	NE	0.0057						NE	NE	NE	
F. Other Land	131.6759	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
G. Harvested Wood Products	-30.0233											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3159**	**59.6532**	**0.2432**						**0.1630**	**2.8412**	**2.0097**	**0.0059**
A. Solid Waste Disposal	NA, NO	45.5148							NA, NO	NA, NO	1.9364	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.3159	0.3341	0.0077						0.1630	2.8412	0.0629	0.0059
D. Wastewater Treatment and Discharge		13.8043	0.2355						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	82.6894	0.0027	0.0027						0.3600	0.1894	0.0734	0.0262
Aviation	82.6894	0.0027	0.0027						0.3600	0.1894	0.0734	0.0262
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	343.3412											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9686**									
Indirect CO_2	**60.4006**											

2011

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**7115.7241**	**119.0761**	**5.5240**	**119.5378**	**0.0403**	**NO**	**0.0000**	**NO**	**41.2523**	**136.9815**	**60.7789**	**17.8646**
1. Energy	**9230.5492**	**28.6717**	**0.1637**						**39.4830**	**131.6881**	**24.2590**	**17.2073**
A. Fuel Combustion — Reference Approach	9135.9071											
Sectoral Approach	9229.2351	2.2555	0.1637						39.4830	131.6881	23.2423	17.2073
1. Energy Industries	4181.2774	0.0859	0.0152						11.4061	1.8179	0.3760	6.6957
2. Manufacturing Industries and Construction	599.6756	0.0273	0.0038						1.6749	0.5802	0.0746	2.1379
3. Transport	2116.7005	0.4384	0.1228						21.5408	104.1850	19.7559	3.1333
4. Other Sectors	2309.8144	1.7026	0.0214						4.7683	24.9419	3.0066	5.0153
5. Other	21.7672	0.0013	0.0005						0.0928	0.1631	0.0292	0.2251
B. Fugitive Emissions from Fuels	1.3141	26.4162	0.0000						0.0000	0.0000	1.0167	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.3141	26.4162	0.0000						0.0000	0.0000	1.0167	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**578.2196**	**NO**	**NO**	**119.5378**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6013**	**2.2818**	**34.4817**	**0.6513**
A. Mineral Industry	491.5026								1.5377	1.2638	0.0155	0.6282
B. Chemical Industry	NO	NO	NO						NO	NO	0.0157	NO
C. Metal Industry	12.8556	NO	NO	NO	NO	NO	NO	NO	0.0418	0.5465	0.0169	0.0193

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	72.7635	NO	NO						0.0078	0.0443	29.2885	0.0039
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				119.5378	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.0979	NO	NO	NO	0.0403	NO	0.0000	NO	0.0140	0.4272	0.4990	NO
H. Other									NO	NO	4.6461	NO
3. Agriculture	**3.6752**	**29.7443**	**4.8884**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		26.8550										
B. Manure Management		2.8892	1.2930								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.5954									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	3.6752											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-2713.1019**	**0.0068**	**0.2313**						**0.0049**	**0.1772**	**NE**	
A. Forest Land	-2373.3313	0.0047	0.0003						0.0030	0.1065	NE	
B. Cropland	-400.4227	0.0021	0.2252						0.0019	0.0707	NE	
C. Grassland	-442.6724	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	61.5457	NE	0.0058						NE	NE	NE	
F. Other Land	466.0972	NE	NE						NE	NE	NE	
G. Harvested Wood Products	-24.3184											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3820**	**60.6535**	**0.2406**						**0.1631**	**2.8344**	**2.0381**	**0.0060**
A. Solid Waste Disposal	NA, NO	46.2036							NA, NO	NA, NO	1.9649	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.3820	0.3348	0.0077						0.1631	2.8344	0.0630	0.0060
D. Wastewater Treatment and Discharge		14.1151	0.2329						NA, IE	NA, IE	0.0103	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	95.4144	0.0032	0.0031						0.3984	0.2213	0.0959	0.0303
Aviation	95.4144	0.0032	0.0031						0.3984	0.2213	0.0959	0.0303
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	386.2234											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9688**									
Indirect CO_2	**65.5327**											

2012

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**6489.1628**	**117.1909**	**4.2108**	**128.8468**	**0.0403**	**NO**	**0.0000**	**NO**	**38.4685**	**123.6520**	**59.7134**	**16.9376**
1. Energy	**8897.8193**	**28.4484**	**0.1527**						**36.7628**	**117.4788**	**21.3257**	**16.3476**
A. Fuel Combustion Reference Approach	8791.1695											
Sectoral Approach	8896.5089	2.4119	0.1527						36.7628	117.4788	20.3960	16.3476
1. Energy Industries	4190.8271	0.0806	0.0144						11.4154	1.6530	0.3687	6.3171
2. Manufacturing Industries and Construction	563.6377	0.0232	0.0032						1.5729	0.5298	0.0671	1.5965
3. Transport	1862.8628	0.3734	0.1120						19.0501	87.9904	16.6961	2.8130
4. Other Sectors	2271.4679	1.9341	0.0229						4.6777	27.1805	3.2403	5.5744
5. Other	7.7134	0.0006	0.0002						0.0466	0.1251	0.0239	0.0466
B. Fugitive Emissions from Fuels	1.3104	26.0365	0.0000						0.0000	0.0000	0.9297	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.3104	26.0365	0.0000						0.0000	0.0000	0.9297	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**586.7346**	**NO**	**NO**	**128.8468**	**0.0403**	**NO**	**0.0000**	**NO**	**1.5106**	**2.1929**	**36.3735**	**0.5841**
A. Mineral Industry	496.8003								1.4504	1.2952	0.0157	0.5606
B. Chemical Industry	NO	NO	NO						NO	NO	0.0150	NO
C. Metal Industry	12.6973	NO	NO	NO	NO	NO	NO	NO	0.0413	0.5398	0.0171	0.0191
D. Non-energy Products From Fuels and Solvent Use	76.1943	NO	NO						0.0088	0.0500	31.3721	0.0044
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				128.8468	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.0427	NO	NO	NO	0.0403	NO	0.0000	NO	0.0101	0.3078	0.4739	NO
H. Other									NO	NO	4.4796	NO
3. Agriculture	**5.5908**	**28.1173**	**3.5815**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		25.3728										
B. Manure Management		2.7445	1.1839								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			2.3976									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	5.5908											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-3017.3416**	**0.0504**	**0.2380**						**0.0322**	**1.1504**	**NE**	
A. Forest Land	-2208.0703	0.0501	0.0028						0.0320	1.1403	NE	
B. Cropland	-476.4351	0.0003	0.2338						0.0003	0.0101	NE	
C. Grassland	-426.1414	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	11.8308	NE	0.0015						NE	NE	NE	
F. Other Land	87.3375	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
G. Harvested Wood Products	-5.8631											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3598**	**60.5748**	**0.2386**						**0.1629**	**2.8300**	**2.0142**	**0.0060**
A. Solid Waste Disposal	NA, NO	45.7457							NA, NO	NA, NO	1.9411	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.3598	0.3343	0.0077						0.1629	2.8300	0.0629	0.0060
D. Wastewater Treatment and Discharge		14.4948	0.2309						NA, IE	NA, IE	0.0102	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	107.6790	0.0031	0.0034						0.4332	0.2338	0.1073	0.0342
Aviation	107.6790	0.0031	0.0034						0.4332	0.2338	0.1073	0.0342
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	404.3122											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.7371**									
Indirect CO_2	**70.0614**											

2013

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**5871.5812**	**114.8765**	**5.7704**	**137.5611**	**0.0403**	**NO**	**0.0000**	**NO**	**37.4833**	**122.3843**	**58.9806**	**19.8122**
1. Energy	**7835.9759**	**27.2620**	**0.1535**						**35.5789**	**116.6533**	**21.0355**	**19.1181**
A. Fuel Combustion Reference Approach	7706.7256											
Sectoral Approach	7834.3318	2.4637	0.1535						35.5789	116.6533	20.1562	19.1181
1. Energy Industries	3310.5699	0.0656	0.0141						9.1042	1.4032	0.2912	7.2180
2. Manufacturing Industries and Construction	599.5639	0.0310	0.0044						1.6913	0.6181	0.0799	2.6151
3. Transport	1972.4617	0.3736	0.1114						20.1215	86.1610	16.3683	3.0321
4. Other Sectors	1947.9381	1.9933	0.0235						4.6348	28.4029	3.4037	6.2194
5. Other	3.7983	0.0003	0.0001						0.0271	0.0682	0.0131	0.0335
B. Fugitive Emissions from Fuels	1.6441	24.7983	0.0000						0.0000	0.0000	0.8793	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.6441	24.7983	0.0000						0.0000	0.0000	0.8793	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**631.7162**	**NO**	**NO**	**137.5611**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7172**	**2.0236**	**35.7659**	**0.6881**
A. Mineral Industry	551.5523								1.6760	1.4190	0.0171	0.6722
B. Chemical Industry	NO	NO	NO						NO	NO	0.0159	NO
C. Metal Industry	7.6569	NO	NO	NO	NO	NO	NO	NO	0.0249	0.3250	0.0100	0.0115

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
D. Non-energy Products From Fuels and Solvent Use	71.3632	NO	NO						0.0088	0.0501	29.0945	0.0044
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				137.5611	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.1438	NO	NO	NO	0.0403	NO	0.0000	NO	0.0075	0.2296	0.5199	NO
H. Other									NO	NO	6.1085	NO
3. Agriculture	**4.1840**	**28.4554**	**5.1458**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		25.7538										
B. Manure Management		2.7015	1.1095								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			4.0363									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	4.1840											
I. Other Carbon-containing Fertilizers	NO, NE											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-2616.6284**	**0.0374**	**0.2304**						**0.0246**	**0.8819**	**NE**	
A. Forest Land	-2055.1211	0.0348	0.0019						0.0222	0.7921	NE	
B. Cropland	-458.6019	0.0026	0.2270						0.0024	0.0898	NE	
C. Grassland	-277.4696	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	11.8308	NE	0.0015						NE	NE	NE	
F. Other Land	87.3375	NE	NE						NE	NE	NE	
G. Harvested Wood Products	75.3959											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.3335**	**59.1217**	**0.2408**						**0.1626**	**2.8255**	**2.1793**	**0.0060**
A. Solid Waste Disposal	NA, NO	43.3916							NA, NO	NA, NO	2.1063	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.3335	0.3337	0.0077						0.1626	2.8255	0.0628	0.0060
D. Wastewater Treatment and Discharge		15.3964	0.2331						NA, IE	NA, IE	0.0102	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	130.4626	0.0046	0.0042						0.5235	0.3098	0.3098	0.0414
Aviation	130.4626	0.0046	0.0042						0.5235	0.3098	0.3098	0.0414
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	431.4636											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.0310**									
Indirect CO_2	**65.1517**											

2014

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**6537.6243**	**117.4727**	**6.4144**	**151.3701**	**0.0403**	**NO**	**0.0000**	**NO**	**41.2896**	**160.2992**	**72.1587**	**22.5976**
1. Energy	**8581.9429**	**28.3945**	**0.1776**						**39.4038**	**155.1296**	**25.7186**	**21.9002**
A. Fuel Combustion Reference Approach	8429.1226											
Sectoral Approach	8580.2708	4.5816	0.1776						39.4038	155.1296	24.9414	21.9002
1. Energy Industries	4014.9274	0.0810	0.0153						10.9980	1.8876	0.3667	6.8685
2. Manufacturing Industries and Construction	585.7254	0.0274	0.0038						1.6513	0.5392	0.0740	2.2402
3. Transport	2049.6073	0.3748	0.1051						20.7783	86.9611	16.5327	3.1761
4. Other Sectors	1927.7357	4.0980	0.0533						5.9605	65.6711	7.9546	9.5958
5. Other	2.2750	0.0003	0.0001						0.0156	0.0705	0.0134	0.0196
B. Fugitive Emissions from Fuels	1.6721	23.8129	0.0000						0.0000	0.0000	0.7772	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.6721	23.8129	0.0000						0.0000	0.0000	0.7772	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**652.4526**	**NO**	**NO**	**151.3701**	**0.0403**	**NO**	**0.0000**	**NO**	**1.7200**	**2.2174**	**44.1349**	**0.6915**
A. Mineral Industry	548.2551								1.6573	1.4047	0.0167	0.6644
B. Chemical Industry	NO	NO	NO						NO	NO	0.0161	NO
C. Metal Industry	13.7976	NO	NO	NO	NO	NO	NO	NO	0.0449	0.5868	0.0186	0.0207
D. Non-energy Products From Fuels and Solvent Use	89.3660	NO	NO						0.0128	0.0723	37.2835	0.0064
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				151.3701	NO	NO	NO	NO				
G. Other Product Manufacture and Use	1.0338	NO	NO	NO	0.0403	NO	0.0000	NO	0.0050	0.1535	0.4699	NO
H. Other									NO	NO	6.3301	NO
3. Agriculture	**10.2058**	**30.1482**	**5.7851**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		27.2645										
B. Manure Management		2.8838	1.2202								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			4.5649									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	10.2058											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-2723.2521**	**0.0049**	**0.2083**						**0.0037**	**0.1341**	**NE**	
A. Forest Land	-2019.3088	0.0029	0.0002						0.0018	0.0651	NE	
B. Cropland	-582.4370	0.0020	0.2069						0.0019	0.0690	NE	
C. Grassland	-271.1606	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	18.7098	NE	0.0013						NE	NE	NE	
F. Other Land	70.4783	NE	NE						NE	NE	NE	

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
G. Harvested Wood Products	60.4660											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.2752**	**58.9252**	**0.2434**						**0.1621**	**2.8182**	**2.3051**	**0.0059**
A. Solid Waste Disposal	NA, NO	43.3232							NA, NO	NA, NO	2.2326	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.2752	0.3327	0.0077						0.1621	2.8182	0.0626	0.0059
D. Wastewater Treatment and Discharge		15.2693	0.2357						NA, IE	NA, IE	0.0100	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	154.5065	0.0034	0.0049						0.6256	0.3250	0.1444	0.0490
Aviation	154.5065	0.0034	0.0049						0.6256	0.3250	0.1444	0.0490
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	1317.1650											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**1.1763**									
Indirect CO_2	**83.0575**											

2015

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
Total national emissions and sinks	**6490.9952**	**114.5375**	**5.2785**	**179.4375**	**0.0403**	**NO**	**0.0000**	**NO**	**43.2364**	**169.6707**	**70.3063**	**294.2491**
1. Energy	**8759.0707**	**27.5275**	**0.1936**						**41.4066**	**164.0111**	**26.8381**	**292.9100**
A. Fuel Combustion Reference Approach	8606.2644											
Sectoral Approach	8757.4126	4.8634	0.1936						41.4066	164.0111	26.1223	292.9100
1. Energy Industries	4141.2201	0.0717	0.0136						11.2794	1.4073	0.3526	203.2479
2. Manufacturing Industries and Construction	665.6173	0.0407	0.0056						1.9040	2.2239	0.1007	24.1751
3. Transport	2158.1164	0.3941	0.1175						21.9992	90.0932	17.1297	5.1060
4. Other Sectors	1790.2120	4.3567	0.0568						6.2097	70.2315	8.5288	59.7859
5. Other	2.2468	0.0002	0.0001						0.0144	0.0551	0.0105	0.5951
B. Fugitive Emissions from Fuels	1.6581	22.6641	0.0000						0.0000	0.0000	0.7158	0.0000
1. Solid Fuels	NO	NO	NO						NO	NO	NO	NO
2. Oil and Natural Gas	1.6581	22.6641	0.0000						0.0000	0.0000	0.7158	0.0000
C. CO_2 Transport and Storage	NO											
2. Industrial Processes and Product Use	**614.5157**	**NO**	**NO**	**179.4375**	**0.0403**	**NO**	**0.0000**	**NO**	**1.6503**	**2.1966**	**41.1605**	**1.3330**
A. Mineral Industry	509.6941								1.5815	1.2964	0.0160	1.2687
B. Chemical Industry	NO	NO	NO						NO	NO	0.0114	NO
C. Metal Industry	17.2258	NO	NO	NO	NO	NO	NO	NO	0.0560	0.7325	0.0221	0.0427
D. Non-energy Products From Fuels and Solvent Use	86.8119	NO	NO						0.0089	0.0503	36.0209	0.0216

SOURCES OF GHG EMISSIONS	Net CO_2 Emissions/ sinks	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	NO_x	CO	NMVOC	SO_2
	(kt)			(kt CO_2 equivalent					(kt)			
E. Electronic Industry				NO	NO	NO	NO	NO				
F. Product Use as Substitutes for ODS				179.4375	NO	NO	NO	NO				
G. Other Product Manufacture and Use	0.7840	NO	NO	NO	0.0403	NO	0.0000	NO	0.0038	0.1174	0.3564	NO
H. Other									NO	NO	4.7339	NO
3. Agriculture	**5.8323**	**28.9985**	**4.6440**						**NO**	**NO**	**NE, NO**	
A. Enteric Fermentation		26.1841										
B. Manure Management		2.8145	1.1814								NO	
C. Rice Cultivation		NO										
D. Agricultural Soils			3.4625									
E. Prescribed Burning of Savannas		NO	NO						NO	NO	NO	
F. Field Burning of Agricultural Residues		IE	IE						IE	IE	NO, NE	
G. Liming	NO											
H. Urea Application	5.8323											
I. Other Carbon-containing Fertilizers	NO											
J. Other	NO	NO	NO						NO	NO	NO	
4. LULUCF	**-2904.5678**	**0.0283**	**0.1962**						**0.0186**	**0.6651**	**NE**	
A. Forest Land	-2027.2895	0.0265	0.0015						0.0169	0.6041	NE	
B. Cropland	-727.4181	0.0018	0.1930						0.0017	0.0610	NE	
C. Grassland	-306.2291	NE	NE						NE	NE	NE	
D. Wetlands	NO	NE	NE						NE	NE	NE	
E. Settlements	38.8867	NE	0.0017						NE	NE	NE	
F. Other Land	60.8445	NE	NE						NE	NE	NE	
G. Harvested Wood Products	56.6377											
H. Other	NO	NO	NO						NO	NO	NO	
5. Waste	**16.1442**	**57.9832**	**0.2448**						**0.1609**	**2.7979**	**2.3076**	**0.0060**
A. Solid Waste Disposal	NA, NO	43.4861							NA, NO	NA, NO	2.2355	
B. Biological Treatment of Solid Waste		NO, NE	NO, NE						NO, NE	NO, NE	NO, NE	
C. Incineration and Open Burning of Waste	16.1442	0.3301	0.0076						0.1609	2.7979	0.0621	0.0060
D. Wastewater Treatment and Discharge		14.1671	0.2371						NA, IE	NA, IE	0.0101	
E. Other	NO	NO	NO						NO	NO	NO	
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items												
International Bunkers	218.4093	0.0058	0.0070						0.9142	0.4451	0.2206	0.0689
Aviation	218.4093	0.0058	0.0070						0.9142	0.4451	0.2206	0.0689
Navigation	NO	NO	NO						NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	1439.8048											
CO_2 Captured and Stored	NO											
Long-term Storage of C in waste disposal sites	NO											
Indirect N_2O			**0.9361**									
Indirect CO_2	**80.0300**											

Annex 2: Mitigation actions and their effect in the Republic of Moldova

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year			The cost of the policy or measure (type and level of funding/support)
		With additional measures (*)									2015	2020	2030	
1	Development of the legal framework on energy performance of buildings	*	Energy	CO_2	Legal framework for promotion of energy performance of buildings	Regulation	Adopted, Planned	Transposition of the EU Directive. Approval of the Law on the Energy Performance of Buildings relevant, Regulations and Methodologies.	2016-2018	MRDC		NA		1.5 mil lei, budget
2	Promotion of buildings with almost zero energy consumption	*	Energy	CO_2	Reducing of energy consumption per m^2	Regulatory, Fiscal, Research	Adopted, Planned	Development and adoption of financial incentives, action plans, feasibility studies to promote the improvement of energy performance of buildings.	(2013-2020)	MRDC		NA		Energy sector spending strategy
3	Measures to improve energy efficiency in residential buildings	*	Energy	CO_2	Reducing energy consumption	Economic	Adopted, Planned	Development of financial instruments supporting energy efficiency measures in the building sector through the MoREEFF Program	2012-2017	Beneficiaries	2.8	72.8		171.9 mil lei
4	Improving energy efficiency in public building	*	Energy	CO_2	Improving energy efficiency in public buildings	Economic	Adopted, Planned	Improving energy efficiency and use of RES, including biomass, in the public construction sector based on implementation of sector programmes in 3 development regions (North, Centre, South) on energy efficiency in public buildings	(2013-2020)	Local governments with support from the MF and EEA	41.5	110.6		EEF, MSIF, E5P
5	Energy efficiency in public street lighting	*	Energy	CO_2	Implementation of energy-efficient lighting	Economic	Adopted, Planned	Optimizing electricity consumption by implementing energy efficient lighting systems during reconstruction or modernization of public lighting system	2013-2018	Local governments with support from the MF and EEA	0.7	2.3		EEF, MSIF, E5P, PEBM
6	Energy efficiency in municipal / regional water supply and wastewater disposal services	*	Energy	CO_2	Reducing energy consumption by the water supply and sewerage services	Economic	Adopted, Planned	Installation of new more efficient pumping and control facilities and systems, as well as sensors to enhance the automation system, with energy savings up to 20%.	2013-2018	JSC „Apa-Canal Chisinau" and other municipal / regional services	1.7	4.8		EBRD, EIB, EU, National Ecological Fund
7	Own energy efficiency programs of electricity transmission and distribution operators	*	Energy	CO_2	Reducing energy losses in the grids	Economic	Adopted, Planned	Development and promotion of software allowing to reduce energy losses in the grid	2013-2018	Gas network operators	24.9	30.0		Network operators
8	Cost-efficient improvements of energy efficiency in the natural gas network infrastructure with related savings	*	Energy	CH_4	Reducing natural gas losses	Economic	Adopted, Planned	Reducing technologic consumption and gas losses in natural gas transmission and distribution networks	2016-2018	Network operators		61.9		Gas network operators

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year			The cost of the policy or measure (type and level of funding/support)
9	Improving the gas consumption metering and billing by implementing the cutting-edge technologies	*	Energy	CH_4	Efficient use of natural gas	Economic	Adopted, Planned	Currently, not all consumers have meters. Metering will entail motivation for efficient gas consumption.	2013-2019	Network operators	1.7	2.3		Gas network operators
10	Developing the regulatory framework and designing the monitoring system for the thermal energy sector	*	Energy	CO_2, CH_4, N_2O	Regulatory framework for monitoring heat consumption	Regulation	Adopted, Planned	The legal framework will provide for favorable conditions for the heat sector development, including: development of the data base, plans to produce heat in cogeneration mode and by using the RES, etc.	2013-2018	MF, MRDC, EEA		N/A		Budget
11	Own energy efficiency programs of the thermal energy sector	*	Energy	CO_2	Optimizing production and distribution of thermal energy	Economic	Adopted, Planned	The main activities will include reconstruction and upgrading of existing heat plants into cogeneration plants; replacement of the existing heat points with individual heating points; thermal energy metering, etc.	2013-2018	„Termoelectrica", „CET Nord" EEA	7.4	45.5		Ebrd E5P
12	Promoting energy efficiency in the land transport sector	*	Transport	CO_2, N_2O	Optimizing fuel consumption in the transport sector	Economic, Regulatory, fiscal	Planned	Renewal of public transport in Chisinau; tire labeling regulation; traffic optimization in towns and villages; restructuring of railways; rehabilitation of streets; optimization of parking system; charges for emissions; etc.	2016-2025	MTRI, AEE, local authorities	0.3	79.2		THE EIB, THE EBRD, IFI, GEF
13	Upgrading and retrofitting of the industrial sector using financial incentives	**	Industry	CO_2, CH_4, N_2O	Financing of energy efficiency projects	Economic	Implemented, planned	Supporting the funding tools for energy efficiency projects in the sector by setting up a credit line (grant component of 5-20%) for the industrial sector. Loans shall be provided for investing in energy consumption reduction technology or use of RES	2012-2020	Credit line MoSEEF, EBRD	21	30.3		EBRD
14	Promoting and installing natural gas condensing gas boilers	*	Energy	CO_2	Use of natural gas condensing gas boilers for heating houses, offices etc.	Economic	Planned	In condensing natural gas boilers, the latent heat of condensation of vapors from flue gas is used, thus the boiler efficiency is increasing by 10-15%, as compared to regular natural gas boilers. Thermal capacity of these boilers is up to 100 kW. Such natural gas condensing boilers are used for heating of houses, offices and other spaces.	2020-2030	MEI		11.9	19.6	372 mil lei from the State budget, external assistance
15	Construction of interconnections with ENTSO-E power system	*	Energy	CO_2	Construction of two interconnections with the Romanian power system	Economic	Planned	Provision is made for construction of 2 interconnections with the Romanian power system - 2/3 of its capacity in 2020, and 1/3- by 2027. Producers and suppliers from Ukraine and CTEM will be able to participate in tendering for selling the electricity on the competitive electricity market in Moldova.	2020-2030	MEI Partner: „Moldelectrica" S.E.		A minimum of 10% compared to CO_2 emissions in the baseline scenario		10 310 mil lei from the State budget, external assistance, other

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year			The cost of the policy or measure (type and level of funding/support)
16	Implementation of distributed electricity generation by using high-efficient gas fired heat and power plants	**	Energy	CO_2	Environmental, economic, social benefits, and reducing dependence on fuel imports	Economic	Planned	Technology allows to gain environmental, economic, social benefits, and reduce dependence on imported energy. Combined heat and power production at the small capacity CHPs becomes more advantageous compared to separate production of heat and electricity when the Load Factor of thermal power exceeds 4500 hours.	2020-2030	MEI Partner: „Moldelectrica” S.E.		41.4		462 mil lei external assistance, other
17	Reducing losses in the heat transmission and distribution system and in production thereof	*	Energy	CO_2	Replacing and upgrading the existing pipelines	Economic	Planned	Replacing the existing networks with pre-insulated pipes, upgrading of thermal points, use of automatically tuned thermal systems, upgrading the pumping stations of the thermal power network.	2020-2030	MEI		24.3		5670 mln lei external assistance, other
		**											31.9	7410 mil lei
18	Promotion and construction of wind power plants connected to the grid	*	Energy	CO_2	Placement of wind turbines	Economic	Planned	In Moldova there are areas where the average annual wind speed at the height of 100 m above the ground is equal to 7.0-7.5 m/sec. IIIA class wind turbines are recommended for such locations, where effective operation can be achieved if the wind speeds is in the range from 5.5 to 8.5 m/sec. The power of one group is 1.8 - 3.0 MW, the tower height is 80-120 m. Given the wind conditions of the RM, these turbines would work at a nominal capacity for 2.2 - 2.6 thousand hours annually	2020-2030	MEI		646.4		12 000 mil lei, other
		**										646.4		12 000 mil lei, other
19	Promotion and construction of photovoltaic power plants connected to the grid	*	Energy	CO_2	Direct conversion technology	Economic	Planned	Exclusion of intermediate transformation from technological chain, lack of movement, noise, vibrations, availability of a modular construction, useful life of over 25 years, are arguments in favor of the photovoltaic technology as the future of energy decentralization .	2020-2030	MEI, ANRE		24.1		930 mil lei, other
		**										240.8		9 300 mil lei, other
20	Use of landfill gas based electricity generation groups to produce electricity and heat	*	Energy	CO_2	Combined energy production from biomass waste	Economic	Planned	Biogas-based generation group is a combined energy unit. It consists of a diesel engine adapted to biogas supply and a synchronous generator which supplies electricity into the grid. In the past five years this technology develops in Moldova as well, where the available biomass waste is used to produce biogas.	2020-2030	MEI, ANRE		10.7		123 thousand lei external assistance, other
		**										53.7		616 thousand lei external assistance, other

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year	The cost of the policy or measure (type and level of funding/support)
21	Promoting the use of biodiesel as fuel	*	Transport	CO_2	Biodiesel produced from various vegetable oils to replace diesel fuel	Economic	Planned	Biodiesel is used to substitute diesel fuel, and it is produced by mixing fossil fuel in various proportions. In Europe, fuel standards allow for up to 5% of biodiesel because of the limitations imposed by fuel and vehicle specifications. Use of more than 20% mixtures may require some modest adjustments to the vehicle. Biodiesel can be produced from various vegetable oils, rapeseed and soybeans, palm oil and animal fats.	2020-2030	MEI	270.0	232 mil lei, other
22	Promotion of bioethanol production	*	Transport	CO_2	Bioethanol product from sugar or starch-based crops.	Economic	Planned	Bioethanol can be produced from sugar crops or can be starch-based. Bioethanol is mixed with gasoline in proportions from 5 to 85%. Smaller proportions of the mixture are used in conventional gasoline engines. Mixtures containing more than 10% of bioethanol can be used in modified engines. The bioethanol production process starts from processing the raw material to get the sugar, then add yeast for fermentation.	2020-2030	MEI	119.0	245 mil lei, other
23	Construction of good and very good roads	*	Transport	CO_2	Transport strategy and logistics	Economic	Planned	The transport and logistics strategy for 2013-2022 defines the unsatisfactory condition of public roads (74% of the national roads length and 78% of the local roads length). The action plan to the strategy provides for achieving the target of 45% of roads in good condition by year 2022. An increase of the share of roads in good condition by up to 80% is assumed by 2030. Achieving this objective will entail up to 20% fuel economy.	2020-2030	MTRI	324.0	76 400 mil lei from the Road Fund, external assistance
		**									197.2	46 500 mil lei
24	Promoting energy efficiency in rail road transport	*	Transport	CO_2	Renovation of passenger and freight rolling stock	Economic	Planned	The transport and logistics strategy for 2013-2022 provides for investment in renovation of the passenger and freight rolling stock, the shunting locomotives and lines, equipment and machinery for railways maintenance and repair, as well as investment in the railway networks rehabilitation.	2020-2030	MTRI	24.0	10.5 mil lei from the State budget, external assistance, other
		**									14.6	6.4 mil lei from the State budget, external assistance, other
25	Tire labeling, procurement of energy efficient transport, optimizing the traffic on the central streets of towns and villages	*	Transport	CO_2	Promoting efficient tyres in terms of fuel consumption	Economic	Planned	Among the objectives set out in the National Energy Efficiency Programme for 2011-2020 for the transport sector are increased safety and economic and environmental efficiency by promoting fuel consumption efficient tires. It is estimated that implementation of these measures and actions by 2020 will result in about 20% fuel consumption reduction.	2020-2030	MTRI, MEI, MF, Public Procurement Agency	638.0	1 mil lei from the State budget, other

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year			The cost of the policy or measure (type and level of funding/support)
26	Increasing the heat resistance of the buildings envelope	*	Energy	CO_2	Measures of increasing the thermal resistance of the building envelope	Economic	Adopted, Planned	Measures of increasing the thermal resistance of building envelope include walls insulation, replacement of old windows with new, double glazing technology windows, replacement of doors, etc.	2020-2030	MEI, MTRI			284.8	11 160 mil lei from the State budget, external assistance, EEF, other
		**											98.4	3 850 million lei from the State budget, external assistance, EEF
27	Installing thermostatic valves for regulating temperature in living quarters	*	Energy	CO_2	Temperature regulation in rooms	Economic	Planned	In the district heating supply, the temperature of the heating fluid is controlled at source, by regulating the water temperature in the pipeline. Installation of thermostatic taps at every heating body will allow to change the temperature in individual rooms from 10 to 12°C during the periods when they are not used, what accounts for 50% of the time.	2020-2030	EEA			85.7	3.17 mil lei EEF, external assistance, other
28	Installing thermostatic valves for regulating temperature in public buildings, including by day / night mode	*	Energy	CO_2	Temperature regulation in the public buildings premises	Economic	Planned	The work schedule in the administrative buildings is about 10 hours during 5 days a week. During the rest of the time, the temperature inside may be lowered to 10-12°C, as a “night mode”	2020-2030	EEA			70.8	1.7 mil lei EEF, external assistance, other
29	Replacing the incandescent bulbs with energy efficient LED bulbs	*	Energy	CO_2	Use of LED bulbs	Economic	Implemented, Planned	The currently used incandescent bulbs have a light output of 10-12 lm/W, while in energy efficient LED type bulbs this indicator is 100 lm/W. If the average light intensity is 10 W/m^2 then this indicator in LED bulbs will be 1W/m^2.	2020-2030	EEA			414.5	782 mil lei EEF, external assistance, other
30	Installing heat meters in each apartment	*	Energy	CO_2	Reducing heat consumption	Economic	Planned	Currently the heat consumed in residential buildings apartments is metered at one single meter, installed on the building. Changing the current scheme of vertical heat distribution by a horizontal one requires installation of heat meters in each apartment, what will reduce heat consumption in the building by at least 5%.	2020-2030	EEA			13.5	2.4 mil lei EEF, external assistance, other
31	Use of biomass for energy purpose	*	Energy	CO_2	Biomass based heat plants for educational, cultural institutions, etc.	Economic	Implemented, Planned	Biomass-based heat plants are planned for the preschool education institutions, school, houses of culture, etc. It is expected that heat plants based on use of straw bales and / or wood products (wood pellets, briquettes) will be used in rural areas. The thermal power of such plants is about 12 -750 kW.	2020-2030	EEA, MEI		116.0		100 mil lei EEF, external assistance, other
		**										139.8		120 mil lei

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year			The cost of the policy or measure (type and level of funding/support)
32	Installing low-medium and large capacity heat pumps,	*	Energy	CO_2	Decrease consumption of fossil fuels	Economic	Implemented, Planned	Heat pumps increase the temperature of potentially reduced heat source to the required temperature. The potentially reduced heat source may be the atmospheric air, soil, surface water, ground waters, and also technological sources of heat. Heat pumps use 1 kWh of electricity to generate 3 to 5 kWh of heat.	2020-2030	MEI, EEA		72.9		1940 mil lei EEF, external assistance, other
		**										98.0		2610 mil lei FEE, foreign assistance, other
33	Using solar energy for production of domestic hot water in urban and rural settlements and at enterprises	*	Energy	CO_2	Decrease of fossil fuels consumption	Economic	Implemented, Planned	Production of domestic hot water can be based on successful use of solar panels with vacuum tubes. Vacuuming the tube has a perfect interior insulation effect, which leads to minimizing the heat loss and increasing the efficiency of radiation absorption. Vacuum tubes ensure preheating of the heat carrier in a wide temperature range, increasing the heat yield (up to 80%). Useful life is about 20 years.	2020-2030	MEI, EEA		203.1		1250 mil lei EEF, external assistance, other
		**										130.1		800 mil lei EEF, external assistance, other
34	Implementation of the Energy Management System	*	Industry	CO_2	Methods, techniques and policies to streamline resources and make production cleaner	Education	Planned	The Energy Management System (EMS), introduced by the standard ISO 50001, approved as a national standard in 2012, includes collection, processing and analysis of data on consumption of all forms of energy and energy carriers by various energy consumption points, and proposal of measures eliminating energy losses, implementation of the adopted measures, including results monitoring. The practice of enterprises in the EU shows that implementation of EMS may result in energy consumption reduction at the enterprises by about 10-30%.	2013-2030	MEI, National Institute of standardization, EEA			21.2	22 mil lei, other
35	Use of second generation biofuel for heat production	*	Industry	CO_2	Fast pyrolysis process to obtain different types of biofuel	Economic	Planned	The process takes place at temperatures of 450-800 ° C, by decomposition of lignoceluloze from biomass ultimately resulting in a gaseous biofuel (singaz), solid biofuel (charcoal coal), liquid biofuels (bio oils). The fast pyrolysis process is managed depending on the temperature and duration of pyrolysis process. The amount of fuel can be produced in different proportions. For the RM conditions it is sensible to use installations producing 65-75% liquid biofuels, 20% gaseous biofuel and 15% solid biofuels.	2020-2030	EEA	7.2	36.0		150 mil lei EEF, external assistance, other
		**									5.1	25.7		107.5 mil lei EEF, external assistance, other

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year			The cost of the policy or measure (type and level of funding/support)
36	Promoting energy efficiency in the industrial sector	*	Industry	CO_2	Measures to achieve energy efficiency	Economic	Adopted, Planned	Achieving energy efficiency through: continuous monitoring of energy consumption and technological parameters with highly effective measurement and control systems, automation of industrial processes, installation of heat production equipment for technological processes, reducing heat losses, thermal insulation of steam and hot water pipelines, installation of heat recovery devices in ventilation systems, increasing the heat resistance of the envelope of administrative and industrial buildings	2020-2030	MEI			125.5	393.4 mil lei FEE, external assistance, other
36	Promoting energy efficiency in the industrial sector	**	Industry	CO_2	Measures to achieve energy efficiency	Economic	Adopted, Planned		2020-2030	MEI			61.8	192 mil lei FEE, foreign assistance, Other
37	Substitution of clinker in cement production	*	Industry	CO_2	Reducing use of clinker in cement production	Economic	Planned	The best technologies available on the market can reduce the use of clinker by up to 4%. However, the best alternative is substitution of clinker with other components. The amount of clinker used in cement can be reduced up to 40%. As substituents coal ash, slag, calcinated clay, etc. can be used.	2020-2030	MEI	46.7	467.0		529 mil lei EEF, external assistance, other
37	Substitution of clinker in cement production	**	Industry	CO_2	Reducing use of clinker in cement production	Economic	Planned		2020-2030	MEI	8.3	83.0		94 mil lei EEF, external assistance, other
38	Ensure State support for innovation companies	**	Industry	CO_2	Promotion of innovative technologies with low energy consumption	Economic	Planned	Inclusion of innovation components in the Energy Efficiency Fund Regulation to encourage innovation in conservation and efficient use of energy; extending the financing formula over innovation projects using the formula 1 + 1 for the purchase of new technologies and technology transfer projects; development and implementation of the State Programme of the pre-competitive financing, supporting the testing of models and prototypes.	2013-2020	MEI, EEA, EEF, AITT		5.7		87.5 mil lei, external assistance
39	Program of funding and consultancy to support SMEs	**	Industry	CO_2	Enhancing competitiveness and capacity of SMEs	Economic	Planned	Credit line EU4Business-EBRD provides support to Moldovan SMEs in using the opportunities to access the open market provided by the Association Agreement to the deep and comprehensive free trade zone (AA/DCFTA). EU4Business has 3 components: 1) LET- the list of eligible technologies, which offer loans up to EUR 300 thousand and a 5% grant component for purchasing equipment and technologies; 2) SPS-FS to increase quality and safety of food products with a 15% grant component and the loan of up to EUR 300 thousand; 3) Complex Projects Approach, which provides loans of up to EUR 3 million and a 15% grant component for the industrial sector modernization.	2017-2018	Credit line EU4Business		14.4		EBRD 10 mil EUR

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year	The cost of the policy or measure (type and level of funding/support)
40	Adjusting the national legal framework to the EU legislation (EC Regulation No. 842/2006 concerning certain fluorinated gases with greenhouse effect) to the gradual suppression of some GHG F-gases	*	Industry	CO_2	Regulation of some GHG F-gases (HFC, PFC si SF_6)	Regulatory	Planned	Drafting and promoting by a Government Decision of a National Program or Regulation for the regulation of some F-gases (HFC, PFC and SF_6); banning the import of certain types of F-gas products and equipment (new and used); stimulating innovation, development and use of new techniques; drafting and promotion of the Law on amending and completing the Law no. 1540-XIII of 25.02.1998 on environmental pollution payment; establishing and approving annual import quotas for F-gases, products and equipment containing F-gases.	2020-2030	Ministry of Agriculture, Regional Development and Environment, Customs Service, Ministry of Education, Culture and Research	n/a	Does not require a State financial coverage
41	Development / improvement of data reporting system regarding import and consumption of HFC, products and equipment containing HFC, PFC and SF_6	*	Industry	CO_2	Development of the data reporting system, including the electronic one	Economic	Planned	Designing the system, including electronic one, of reporting data on HFC import and consumption, products and equipment with HFCs, PFCs and SF_6.	2020-2030	Ministry of Agriculture, Regional Development and Environment, Customs Service, Technical University of Moldova	n/a	365 mil lei from the State budget, external assistance
42	Training and equipping with available tools / instruments to regulate HFC, PFC and SF_6	*	Industry	CO_2	Development of technical criteria for the training of refrigeration specialists	Education	Planned	Drafting technical criteria, harmonized with the EU Regulations (Regulation No. 305/2008), on training of refrigeration specialists from the refrigeration, air conditioning and electrical equipment sectors where F-gases (PFC and SF6) are used as dielectrics; compulsory training and certification of refrigeration and AC technicians; equipping frigotehnical specialists with tools and equipment for the service of refrigeration and AC systems.	2020-2030	Ministry of Agriculture, Regional Development and Environment, Technical University of Moldova	n/a	1.5 mil lei from the State budget, external assistance
43	Capacity building for the Customs Service of the Republic of Moldova	*	Industry	CO_2	Training of Customs officers	Education	Planned	Drafting/procurement of professional training materials; updating of the Guidelines for customs officials; theoretical and practical training of the staff/customs brokers; equipping the Customs with freon detectors.	2020-2030	Ministry of Agriculture, Regional Development and Environment, Customs Service	n/a	438 mil lei from the State budget, external assistance
44	Gradual reduction of HFC consumption	*	Industry	CO_2	Refrigeration equipment and air conditioning without F-gases	Economic	Planned	Retrofitting and re-use of existing air conditioning and refrigeration equipment operating with HFCs with alternative generating freons, including natural freons (propane, isobutane, isopentane, H2O, NH4, air, helium,CO_2).	2020-2030	Ministry of the Agriculture, Regional Development and Environment	n/a	300 mil lei from the State budget, external assistance

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year			The cost of the policy or measure (type and level of funding/support)
45	Implementation of the „no-till" soil conservation system with 5 sole crop rotation with incorporation into soil of green fertilizer (winter vetch) every 5 years	*	Agriculture	N_2O	Creating a positive balance of humus in agricultural soils	Economic	Planned	"No-Till" is a land conservation system, with sowing directly into stubble. The main working element is the seed drill. The main element of the seed drill is the coulter. The superficial soil layer gradually becomes biogenic, well structured, loose, with favorable air and moisture conditions for nutrition of plants, increasing the resistance to drought. CO_2 emissions will reduce annually by 3.8 t/ha/year.	2020-2030	MADRM			1.2	6400 mil lei from the State budget, foreign aid, other
		**											304.0	1600 million lei from the State budget, external assistance, other
46	Implementation of the „mini-till" soil conservation system with incorporation in soil of green manure cultivated as intermediate crops and / or related by-products.	*	Agriculture	N_2O	Creating a positive balance of humus in agricultural soils	Economic	Planned	This system provides for return of vegetal waste into the soil, keeping part of it as mulch on the soil surphace. It is proposed to improve this system by using vetch as intermediate crop for green fertilizer. CO_2 emissions will reduce annually by 4.6 t/ha/an.	2020-2030	MADRM			1 472.0	7680 mil lei from the State budget, external assistance, other
		**											368.0	1920 million lei from the State budget, external assistance, other
47	Disposal of manure on communal platforms or individual deposit sites.	*	Agricul-ture	NH_4, N_2O	Limiting penetration of nitrates and nitrites into the soil and water, reducing GHG emissions	Economic	Planned	Manure deposited on the waterproof platforms, can be separated. For proper fermentation, it will be covered with a plastic foil to prevent nutrient washing and to reduce volatilization of CH_4 and NH_3. Thus it will become possible to limit penetration into the soil and water of nitrates and nitrites, reduce GHG emissions and obtain valuable organic fertilizers.	2020-2030	MADRM		259.2		1580 mil lei from the State budget, external assistance, other
		**										86.3		530 mil lei from the State budget, external assistance, other
48	Implementation of cattle feeding technologies by using of optimal structure rations, scientifically substantiated	*	Agricul-ture	CH_4	Increase in productivity in the animal husbandry sector	Economic	Planned	The traditional cattle feeding technology in the RM is separate fodder rations - hay, green plants, concentrates, etc. Depending on the physiological status and productivity of livestock the rations differ by the amount and ratio of fodder (structure). If the structure is optimal, the productivity, animal health, digestibility of feed and gas formation in the rumen are at optimal level.	2020-2030	MADRM		79.0		194 mil lei from the State budget, external assistance, other
		**										19.0		45.6 mil lei from the State budget, external assistance, other
49	Promoting cattle feeding technologies by using blended fodder as monoration, with or without small quantities of green fodder	*	Agricul-ture	CH_4	The increase in productivity in the animal husbandry sector	Economic	Implemented, Planned	A technology widely used in countries with developed animal husbandry sector. In the RM this technology is in the process of implementation, and is used in about 15-20% of the cattle herd. The rations calculated based on physiological requirements of animals are mixed evenly with special machines (mixers) and are fed to animals as a single blend. This technology has a positive effect on the level of fodder digestibility, increasing the productivity by up to 20-25% compared to traditional technology.	2020-2030	MADRM		49.0		46 mil lei from the State budget, external assistance, other
		**										27		26 mil lei from the State budget, external assistance, other

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year	The cost of the policy or measure (type and level of funding/support)
50	Inclusion of certain additives in cattle rations (saponins, ionophors) which decreases the levels of methane in the digestion process	*	Agricul-ture	CH_4	Reducing methane emissions	Economic	Planned	The single blends (monorations) for cattle are supplemented with special feed additives containing substances (saponins, ionofore, essential oils, etc.) which affect methane formation and elimination, decreasing this indicator by up to 30%.	2020-2030	MADRM	39.0	38 mil lei from the State budget, external assistance, other
		**									17.0	22 mil lei from the State budget, external assistance, other
51	Promoting the use of grape marc in ruminant rations in order to reduce GHG emissions	*	Agricul-ture	CH_4	Reduction of methane emissions	Economic	Planned	Grapes marc contains substantial amounts of fats and tannins. These substances may reduce the levels of enteric methane formation. A recent research of Australian and New Zealand scientists has shown that the use of grape marc, both dry and as silage milk in dairy cattle rations reduced the level of methane formation in the rumen with 18-23%.	2020-2030	MADRM	34.0	57 mil lei from the State budget, external assistance, other
		**									24.0	40 mil lei from the State budget, external assistance, other
52	Afforestation of lands and water-protection belts of the rivers and water basins	*	LULUCF	CO_2	Decreasing soil erosion	Economic	Implemented, Planned	Planting / rehabilitation of forest belts for protection of rivers and water basins on the area of 30.4 thousand hectares, according to GD no. 593 of 01.08.2011 on approving the National Programme on establishing the national ecological network for the period 2011-2018.	2020-2030	MADRM	-173.5	997 mil lei from the State budget, external assistance, other
53	Improvement of degraded lands by afforestation	*	LULUCF	CO_2	Decreasing soil erosion	Economic	Planned	Expanding the afforested areas on the account of degraded lands, by 50 700 ha.	2030	MADRM	-293.0	1600.6 mil lei from the State budget, external assistance, other
54	Expanding the areas covered with forest vegetation	**	LULUCF	CO_2	Decreasing soil erosion	Economic	Implemented, Planned	Expanding the areas covered with forest vegetation on the account of degraded lands, by 31 300 ha.	2030	MADRM	-179.2	988 mil external assistance
55	Planning of forest protection curtains	**	LULUCF	CO_2	Protection of agricultural lands	Economic	Implemented, Planned	Planting of forest belts to protect agricultural lands.	2030	MADRM, MADRM	-65.7	195.4 mil lei external assistance
56	Planting forest energy crops	**	LULUCF	CO_2	Substitution of fossil fuel	Economic	Planned	Planting of fast growing forest species crops, managed in short production cycles (10-15 years).	2030	MADRM, MEI	370.0	438 mil lei external assistance
57	Construction of regional SWDs and transfer stations in region 1-Cantemir, Cahul, Taraclia, GATU	*	Waste	CO_2	Centralized waste disposal	Economic	Planned	Development of the regional waste disposal infrastructure, construction of a regional solid waste disposal site, 6 transfer stations and deployment of 19 transport units of 16 m^3 capacity for capacity for waste transportation to deposit sites	2018	MADRM	254.3	456 mil lei from the State budget, foreign aid, other
		**									32.3	57 mil lei from the State budget, external assistance, other

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year	The cost of the policy or measure (type and level of funding/support)
58	Construction of regional SWDs and transfer stations in region 2- Leova, Cimislia, Basarabeasca	*	Waste	CO_2	Centralized waste disposal	Economic	Planned	Development of the regional waste disposal infrastructure, construction of a regional solid waste disposal site, 3 transfer stations and deployment of 11 transport units of 16 m^3 capacity for waste transportation to deposit sites	2018	MADRM	151.9	394 mil lei from the State budget, external assistance, other
		**									19.3	50 mil lei from the State budget, external assistance, other
59	Construction of regional SWDs and transfer stations in region 3-Causeni, Stefan Voda	*	Waste	CO_2	Centralized waste disposal	Economic	Planned	Development of the regional waste disposal infrastructure, construction of a regional solid waste disposal site, 2 transfer stations and deployment of 11 transport units of 16 m^3 capacity for waste transportation to deposit sites	2019	MADRM	140.5	395 mil lei from the State budget, external assistance, other
		**									18.0	50 mil lei from the State budget, external assistance, other
60	Construction of regional SWDs and transfer stations in region 5-Ungheni, Nisporeni, Calarasi	*	Waste	CO_2	Centralized waste disposal	Economic	Planned	Development of the regional waste disposal infrastructure, construction of a regional solid waste disposal site, 2 transfer stations and deployment of 19 transport units of 12 m^3 capacity for waste transportation to deposit sites	2020	MADRM	127.7	397 mil lei from the State budget, external assistance, other
		**									16.2	50 mil lei from the State Budget, foreign aid, other
61	Construction of regional SWDs and transfer stations in region 6-Soldanesti, Rezina, Telenesti, Orhei	*	Waste	CO_2	Centralized waste disposal	Economic	Planned	Development of the regional waste disposal infrastructure, construction of a regional solid waste disposal site, 4 transfer stations and deployment of 19 transport units of 13 m^3 capacity for waste transportation to deposit sites	2020	MADRM	143.8	413 mil lei from the State budget, external assistance, other
		**									18.3	52 mil lei from the State Budget foreign aid, other
62	Construction of Construction of regional SWDs and transfer stations in region 8-Briceni, Ocnita, Edineti, Donduseni	*	Waste	CO_2	Centralized disposal of waste	Economic	Planned	Development of the regional waste disposal infrastructure, construction of a regional solid waste disposal site, 4 transfer stations and deployment of 11 transport units of 16 m^3 capacity for waste transportation to deposit sites	2020	MADRM	126.3	408 mil lei from the State budget, external assistance, other
		**									16.0	52 mil lei from the State budget, foreign aid, other
63	Construction of the mechanical-biological treatment center in Region 4- mun. Chisinau, Ialoveni, Straseni, Criuleni, Hancesti, Cocieri, Anenii Noi	*	Waste	CO_2	Centralized waste disposal	Economic	Planned	Development of regional waste disposal infrastructure in Chisinau mun. by building a mechanical-biological treatment station, construction of 1-3 SWDs, 4 transfer stations, deployment of 48 transport units of 16 m^3 capacity for waste transportation.	2020	MADRM	703.6	2910 mil lei from the State Budget, external assistance, other

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year			The cost of the policy or measure (type and level of funding/support)
64	Construction of the mechanical-biological treatment center in Region 7-mun. Balti, Drochia, Floresti, Glodeni, Rascani, Sangerei, Soroca, Falesti	*	Waste	CO_2	Centralized waste disposal	Economic	Planned	Development of regional waste disposal infrastructure in Balti by building a mechanical-biological treatment station, construction of 1-2 SWDs, 7 transfer stations, deployment of 33 transport units of 16 m^3 capacity for waste transportation	2020	MADRM		362.8		2260 mil lei from the State budget, other
65	Recovery of biogas from the SWD in Tantareni	*	Waste	CO_2	Reducing methane emissions	Economic	Planned	Equipping and commissioning the installation for recovering biogas from Tantareni SWD.	2020	MM		47.5		Private 58.5 mil lei
66	Sludge treatment at the wastewater treatment plant in Chisinau and Balti	*	Waste	CO_2	Reducing methane emissions	Economic	Planned	Equipping the technological scheme for waste water treatment employed at the Apa-Canal stations in Chisinau and Balti with technologies for treating the sludge in anaerobic conditions. Technology comprises: methane-tank; pumping station; sludge concentrator; methane storing and combustion systems; dewatering tank; distribution and communications network.	2020	MADRM, MEI		23.2 Chisinau, 5.0 Balti		112.4 mil lei from the State budget, other
67	Promotion of the GD on adoption of the national waste management programme	*	Waste	CO_2	Better environment conditions	Regulation	Planned	Identification of measures to be taken to improve the environmental conditions in the event of preparation for re-use, recycling, recovery and disposal of waste. The program will provide for the phased development of the waste management infrastructure.	2017	MADRM				Budget
68	Promoting GD on adoption of the regulation on waste storage	*	Waste	CO2	Regulating waste storage	Regulation	Planned	Establishing the legal framework regulating waste storage activities, both for the deployment, operation, closing and post-closing of new deposit sites, as well as for operation, closure and post closure monitoring of existent deposit sites.	2017	MADRM				Budget
69	Assessing the energy-saving potential in the RM	*	Cross-sector	CO_2, CH_4, N_2O	More accurate assessment of the energy efficiency potential	Studies	Planned	Currently, there are studies on energy efficiency based savings potential, but these studies reveal a lack of sufficient input and secure data, and lack of connection with the RM's commitments as a Contracting Party to comply with the provisions of the EU directives. The action will lead to overcoming these gaps.	2016-2017	MEI, EEA		N/A		Budget
70	Updating and adopting the legal framework for ensuring implementation of the EED and the Law on Energy Efficiency	*	Cross-sector	CO_2, CH_4, N_2O	Implementation of the EU directive concerning energy efficiency and the law on energy efficiency.	Regulatory	Planned	Updating the regulatory framework (electricity, gas, heat) to implement the requirements of the EED, including for the Law on Public Procurement	2013-2017	MEI, MF, ANRE		N/A		Budget

No.	The name of the policy or measure	With measures (*)	The sector concerned	GHG concerned	The objective and/or activity concerned	Tools used	Implementation status	Description	Implementation period	Entity responsible for the implementation	Mitigation impact, kt CO_2 equivalent/year			The cost of the policy or measure (type and level of funding/support)
71	Development of the bottom-up approach to M & V	*	Cross-sector	CO_2, CH_4, N_2O	Development and implementation of energy savings monitoring and verification (M & V) system	Regulation Information	Planned	The measure aims to develop and implement a monitoring and verification (M & V) system of energy savings resulting from energy efficiency measures, based on the methodology proposed by the European Commission and En-C and additionally developed by the GIZ Open Regional Fund	2016	EEA		N/A		Budget
72	Promote energy service companies (ESCO)	*	Cross-sector	CO_2, CH_4, N_2O	Promote ESCO development	Regulation	Planned	In addition to amending and / or changing the existing legislative and regulatory framework to promote the development of the ESCOs. The action will be accompanied by awareness-raising campaigns aimed at potential beneficiaries of energy services as well as training of prospective suppliers of energy services	2013-2019	MEI		N/A		GEF, EU
73	Study on energy efficiency/ commitments scheme promotion and assessment of its application in the Republic of Moldova	*	Cross-sector	CO_2, CH_4, N_2O	Adopting the energy commitments system	Studies	Planned	The study will provide the public authorities with quality information about the timeliness of commitments implementation system in the RM	2016-2017	EEA		N/A		Budget
74	Labeling. Adoption of tax and customs incentives for products with energy impact	*	Cross-sector	CO_2, CH_4, N_2O	Establishment of a legal framework for energy-efficient products	Regulatory, Fiscal	Planned	The action is aimed at putting in place tax and customs incentives / facilities/benefits	2013-2018	MEI, MADRM, EEA	36.0	88.8		The National Ecological Fund; EEF
75	Education and training, including advisory programs on energy efficiency and RES	*	Cross-sector	CO_2, CH_4, N_2O	Development of skills in energy efficiency and RES	Information, education	Implemented, planned	The measure aims to support the development of skills necessary for the implementation of the legislative / regulatory framework and behavior changes resulting in energy consumption reduction	2016-2018	MEI, MADRM, EEA		N/A		Budget

Annex 3: List of NAMAs Seeking Support for Implementation in the Republic of Moldova, as registered in the UNFCCC NAMA Registry

Note: All NAMAs Seeking Support for Implementation in the Republic of Moldova are available for being downloaded on the Climate Change Office of the Ministry of Agriculture, Regional Development and Environment website: <http://clima.md/lib.php?l=en&idc=278>, respectively on the UNFCCC NAMA Registry website: <http://www4.unfccc.int/sites/nama/SitePages/NamaImplementation.aspx>:

NS-274 Promotion of small scale CHPs in the Republic of Moldova

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=185&viewOnly=1>.

NS-275 Promotion of heat pumps in the Republic of Moldova

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=186&viewOnly=1>.

NS-276 Promotion of wind power plants (WPP) in the Republic of Moldova

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=187&viewOnly=1>.

NS-277 Use of solar energy for domestic hot water production in the Republic of Moldova

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=188&viewOnly=1>.

NS-278 Promoting Energy Efficient Lighting in the Republic of Moldova

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=189&viewOnly=1>.

NS-279 Hybrid and electric buses and minibuses in the city of Chisinau

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=190&viewOnly=1>.

NS-280 Clinker substitution at cement production

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=191&viewOnly=1>.

NS-281 Reducing GHG emissions from Enteric Fermentation by including dried grape marc in cattle ratios

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=192&viewOnly=1>.

NS-282 Implementation of soil conservation tillage system in the Republic of Moldova

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=193&viewOnly=1>.

NS-283 Afforestation of degraded land, riverside areas and protection belts in the Republic of Moldova

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=194&viewOnly=1>.

NS-284 Use of energy willow for heat generation in the Republic of Moldova

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=195&viewOnly=1>.

NS-285 Waste to Energy (WTE) NAMA in the Republic of Moldova

<http://www4.unfccc.int/sites/nama/_layouts/un/fccc/nama/NamaSeekingSupportForImplementation.aspx?ID=196&viewOnly=1>.

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